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How might storytelling and structured visual images be used as a pedagogical strategy by practitioners in furthering understanding the English number system?

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To cite this article: Brettle, D. (2014) *How might storytelling and structured visual images be used as a pedagogical strategy by practitioners in furthering understanding the English number system?.* MA Research module. Birmingham City University. Available at: http://www.crec.co.uk/research-paper-archive/ [Accessed date]

To link to this article: http://www.crec.co.uk/research-paper-archive/2014-017.pdf

Abstract

This research explores subpar understanding of place-value predicts mathematical difficulties. Many practical resources exist to aid learning - could the positive effects of storytelling, coupled with the structured visual image approach, be a useful pedagogical approach? Children whose maths have been supported using structured imagery (numicon) show an improvement in attainment. Egan (2010) has believed for decades that children will engage with new ideas more readily if they are presented in the form of stories. The constructivism theories of Piaget, Vygotsky and Lave and Wenger are discussed along with Cognitive Load Theory. Also the work of Goleman and the impact of his theory of Emotional intelligence and the impact of stress on learning is highlighted.

Families were invited to join the study and written permission was obtained. The children were then asked if they wanted to take part in the study. Children were informed they could withdraw from the study at any time. During a 10 week intervention study, children were reported to be engaged in their learning and made good progress. In an exit diagnostic test, one child in particular recalled part of the stories we'd told to help him answer questions.

Future research on a larger scale, with better resources, can be justified and will provide more valuable insights. There is a value in developing new approaches to learning about the place value number system.

Keywords: mathematics, storytelling, place value, pedgogical, numicon.

How might storytelling and structured visual images be used as a pedagogical strategy by practitioners in furthering the understanding of the English number system, for children in Key Stage One who are underachieving in mathematics?

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MA Double Research Module

Date of submission – 31st July 2014

Word Count - 10,911

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2014

'Research in Professional Practice/Dissertation submitted in part fulfilment of the award of MA Education (Early Years) at Birmingham City University.

CONTENTS PAGE

LIST OF TABLES

LIST OF FIGURES AND PHOTOS

Acknowledgements

I would like to thank my family for their support throughout 2014. I would also like to thank the children who agreed to take part in this study and their parents. In addition I would like to extend my gratitude to the staff at the primary school I work at and the head teacher in particular for agreeing for me to complete my work-based research study in school. My gratitude also goes of course to the wonderful staff at the Centre for Research into Early Childhood (CREC) in Birmingham and to my course tutor, Paola Pedrilli, at Birmingham City University (BCU).

Research Question

How might storytelling and structured visual images be used as a pedagogical strategy by practitioners in furthering the understanding of the English number system for children in Key Stage One who are underachieving in mathematics?

Sub-questions

How are/might storytelling and visual images used as pedagogical tools in other areas of education?

How is the English number system commonly taught?

Are there other pedagogical strategies for mathematics underachievers?

ABSTRACT

A good grasp of place-value understanding is crucial in learning arithmetic. Subpar understanding predicts mathematical difficulties. Many practical resources exist to aid learning but could the positive effects of storytelling, coupled with the structured visual image approach, be a useful pedagogical approach tool? A small scale, work-based, evaluative case study using a mixed methods approach was completed in a UK primary school. During a 10 week intervention study, children were reported to be engaged in their learning and made good progress. Future research on a larger scale, with better resources, can be justified and will provide more valuable insights.

INTRODUCTION

I have worked as a teaching assistant in a primary school for eight years. My position has included specialising in running intervention groups with children who were underachieving in mathematics. I observed that most of the older children who were underachieving had common gaps which usually focussed around place value. Younger children were not able to move on with their learning it seemed as they could not understand the place value number system, and their understanding of 'teen' and 'ty' numbers was not secure.

For example, children who had trouble distinguishing their 'teen' numbers and 'ty' numbers in a count sequence would say, ... "11,12,13,14,15,16,17, 80, 90, 100" or "50, 60, 70, 18, 19, 20". In addition I observed that when some children wanted to write the number 60 they might write 16. They would be unable to securely write a given two digit number, so for example when asked to write 18 they might write 81 and they would be unable to see why this was incorrect.

Children I worked with regularly did not securely understand that five groups of ten and eight is 58 or know that 58 is five groups of ten and eight. Given a calculation 50+8=❒ they would count on in ones instead. They would use the same strategy of counting on in ones to work out more complex calculations too, for example 54+32=❒.

I started to wonder why the standard pedagogical approaches for teaching place value in the classrooms, helped some children understand but not others. In small intervention groups, to tackle the issue of place value I would use Numicon apparatus. Numicon is a resource that represents numbers in the concrete form of plastic tiles (Tacon, Atkinson and Wing 2004). I had some success with this but some children were still left very confused and

they seemed disengaged in the sessions as there was a lot of repetition of activities. It was frustrating for all of us.

As a teaching assistant, part of the role is to make observations of correct answers so we can add this to a child's assessment folder. However, I would also observe other behaviour. I saw behaviour which I interpreted as stress. For example, one 6 year old boy was observed biting his tongue so hard during numeracy that it would bleed. I noticed that when some children answered a question incorrectly they would seem to take a long time to recover and would disengage from any subsequent learning. I empathised with children who did not have their hand up to answer a question but were asked to answer a question anyways. Some children seemed anxious about getting answers wrong but were so 'lost' that they resorted to copying answers from someone else - they would much rather a page of ticks with a stamp that says Learning Objective met. I also observed children who were not engaged in their learning.

Knowing that the new National Curriculum for Numeracy (Department for Education, 2013), will see children taught more complex mathematics at an even younger age, I must admit to having felt anxious myself, on behalf of the children.

Recently I have trained to become a Forest School Leader. One of the books that really interested me was 'Using Story Telling as a Therapeutic Tool with Children' (Sunderland, 2001). I wondered whether storytelling could be a way forward as a pedagogical approach for learning about the number system too. Particularly for those children who had not understood through conventional methods.

I searched high and low for fiction or non-fiction books that might have helped me to teach children about place value. I found a few such as Milbourne and Rigliette (2007) and Pinczes (2000). These were helpful but they still in my opinion did not really explain why we have a place value system and why there are irregularities.

I decided to write a series of short stories myself. They tell the story of how and why a family invented the number system we use today. Also, why we have a base ten system, why some parts are irregular; the teen numbers are read backwards, why we say thirteen not threeteen, why fifty is not called fivety and why when we get to 99, the next number is not tenty but a hundred.

The books were piloted with a child who had special educational needs. I cannot claim that he immediately understood and went on to make great gains in his mathematics. However, I can report that he started to show an understanding, he was certainly engaged in his learning and he appeared to be relaxed during these sessions. He would look forward to sessions; asking in the mornings if we would be reading later. He left each session with a smile. He would sometimes refer to our stories in lessons. For example if the number 13 was mentioned in class which he had previously confused regularly with 15, he would look across at me and hold his nose. We had referred to this as the 'smelly number' in our stories.

My interest in this area intensified and I sought to do some further research. I wanted to learn more about research design and research methodology so I could complete a research project that would be considered rigorous. I also wanted to seek the approval of an ethical panel. With more than a fair amount of trepidation I signed up to a MA Double Research Module.

The research is structured into the following sections:

- The Literature Review
- Methodology
- The results and Data Analysis
- Conclusion and recommendations for future research.

LITERATURE REVIEW

This section is divided into five key areas:

1- Theoretical perspectives

2- Emotions and learning

3- The current issues in maths education in primary schools

4- Current pedagogical methods to teaching place value

5- The reported advantages / disadvantages of using storytelling as a pedagogical approach to teaching in primary schools

1. Theoretical perspectives

Pritchard and Woolard (2013) in my opinion provide a comprehensive summary of the different views of the constructivist approach to education. They write about the key theories and psychologists Dewey, (1859 – 1952), Piaget, (1896 – 1980), Vygotsky, (1896- 1934), Bruner, (1915) and Bandura, (1925). Constructivism has been a real influence on my attitude to teaching and learning. At the heart of constructivism is that children actively construct new knowledge and process new information by associating it with existing knowledge and reflecting on it (Pritchard and Woolard, 2013). The holistic development of children therefore is something they do / they experience, rather than something which they are born with and will continue to develop regardless of their life experiences. Development is not done to them and neither does it happen regardless of experiences (Dolya 2009).

Piaget (1896-1980) believed that learning developed in set stages. For example, by age 7 they should be moving from the Pre-operational Stage to the Concrete Operational Stage.

Children in the Pre-operational Stage are unaware of conservation and exhibit centration. Conservation is the awareness that altering a substance's appearance does not change its basic properties. This is important to maths. When you ask a child to count a number of objects they can say there are 10, but then if you swap positions of two of the objects they may then feel the need to count them again as they have not mastered conservation of number.

Vygotsky (1896-1934) pioneered the Social Development Theory which differs slightly. It proposed that a child's social interactions play the key part in their development. So a child will learn about conservation only by experiencing it, in a setting with others present to model the behaviour or encourage the behaviour. This could be sooner or later than Piaget's stages propose. Vygotsky (1966) believed learning took place in the 'Zone of Proximal Development' and when a 'More Knowledgeable Other' is present. This would suggest to me then that in terms of understanding about the number systems some children need to experience learning about it more than once and in different ways but always in the company of others and that they should do so in the company of someone who knows more than them. They need to see and feel the number system unfold so they can make sense of it themselves in their own way.

According to Vygotsky (1966) humans use tools that develop from a culture, such as speech and writing, to mediate their social environments. He proposed that initially children develop these tools to serve solely as social functions, ways to communicate needs. He believed that the internalization of these tools led to higher thinking skills. To link this to numeracy development is important because children are often required to "reason" about number. For example, to use strategies such as if 3+3=6 then 30+30=60. To do this I believe

children need not just good mathematical skills but crucially they need that internal speech/thought to think a problem through. As they construct this knowledge socially the use of role models and watching others do this or to explain their own reasoning would seem to me to be beneficial.

The view of contextualised learning has also been an influence. This builds on the work of Lave and Wenger (1991). The Situated Learning Theory holds that learning is influenced by the activity, the content and the culture in which it is developed and used. This theory posits that children will learn through an activity even if there is not occasion for social interaction. In terms of understanding the number system, it would suggest that children do not just need to be told about it, experience it and watch others but they need opportunities to practice.

Another paradigmatic theory of interest is that of Cognitive Load. Research by Miller (1956) would suggest that the Working Memory of humans is finite and suggests a capacity of roughly 7 chunks of information. People learn more effectively when then can link the current information to existing schemas (Plass, 2010). This might help explain why children can sometimes count in 2's to 12 but then are unable to go higher. They are remembering the count sequence but not understanding it.

2. Emotions and learning

Whalley (2007) shares that children learn best when they are intrinsically motivated and allowed to follow their own interests, in all areas of learning.

Goleman (1996) believes that learning, including mathematical learning, requires that the learner goes beyond hard facts. It requires emotional engagement and motivation. Goleman (1996) published an influential book called Emotional Intelligence. One of the many things that stood out to me in this book was when he summed up what happens biologically when people are in a state of stress. He reports that when we feel under stress, or are anxious or scared by something, a biological change occurs in the brain. The amygdala is responsible for this. When our brain is in that state we use only that part of our brain and not the other parts like the frontal lobes which are required for learning and understanding (Goleman, 1999). The phrase "Stress makes you stupid" is often associated with Daniel Goleman (Corbin, 2008).

Lawrence (2006) highlights the importance of self-esteem and self image in education. A faulty self-image can sometimes act as a barrier to learning. For example, a child's parents may praise them highly for their mathematical skills but their teacher may suggest differently. He found that in an educational sector, an intervention programme such as a reading group, can be successful not particularly because it will help that individual read but because the adult running the programme can help build the individuals self confidence and increase the self-esteem of the child.

Rattan, Good and Dweck (2012) found that the kind of praise offered to children can have an influence on their engagement in maths. For example they found that people who believe that intelligence is fixed are more likely to give comforting feedback such as "not everyone can be good at maths". However, they found that this 'comforting feedback' made the receiver of the praise disengage.

3. What is Numeracy and what are the big issues in mathematics education?

The word numeracy is used in education as it covers a wider area and stresses the importance of links to the real world, rather than the word mathematics which is principally to do with equations (Askew, 2010).

Celebrity maths champion, Carol Vorderman (see Porkes, 2011) chaired a research taskforce commissioned by the Conservative Party to review the current situation in the UK with regards to mathematics education. The taskforce found that 1 in 4 economically active adults are functionally innumerate. This can be related to the fact that, every year more than 300,000 sixteen year olds conclude their General Certificate of Secondary Education (GCSE) maths course unable to function properly in either their work or personal lives. They also found that a child's mathematical 'career' is effectively determined by the age of 11 as 90% of those who fail to achieve the Standard Assessment Test (SAT) of Level 4 at age 11 will go on to 'fail' GCSE.

The Williams Independent Review of Mathematics Teaching in Early Years Settings and Primary Schools (Williams, 2008) called for a Maths Specialist for every Primary School with an intake of greater than 200 children. In 2008 the government-backed Every Child Counts (ECC), Numbers Count programme started to be rolled out to over 1,700 primary schools; in excess of 20,000 children (Edge Hill University, 2011). The ECC programme provides children aged seven who have the greatest difficulties with numbers with extra tuition for a limited period. An independent review of the ECC programme by Torgeson, Wiggins, Torgeson, Ainsworth, Barmby, Hewett, Jones, Hendry, Askew, Bland, Coe, Higgins, Hodgen, Hulme and Tymes (2011) found that the programme made a moderate improvement in

children's numeracy. However, Torgeson et al (2011) brought attention to the high cost of the programme.

From September 2014, UK Primary Schools will be required to teach the new National Curriculum Mathematics Programme (Department for Education, 2013; DFE-00180-2013). This states that Year One children (5-6 year olds) will be expected to be able to read and write numbers to 100 in numerals as well as be able to count to 100. Some prominent academics in mathematics education have clearly expressed their concerns that the new curriculum will encourage rote learning without understanding (Bassey et al, 2014). Dolya (2009) believes that quality not quantity is important. He highlights that it is socially respected to be able to count to hundred but to understand it is a different thing altogether.

The Williams Review of Mathematics Teaching in Early Years Settings and Primary Schools (Department for Children Schools and Families, DCSF 2008) confirmed that the United Kingdom (UK) is still one of the few advanced nations where it is socially acceptable – fashionable, even – to profess an inability to cope with the subject. Additionally, when parents dispute their own mathematical skills their negative comments could impact on the child. Jones (2014) stresses the importance of not showing a negative attitude to maths to your own child. She writes about this in a blog on www.mumsnet.com entitled "I can't do maths – if you say it then your kids will most likely be saying it."

4. What is place value and what are the current pedagogical methods to teaching place value?

Our number system has a base of ten; ten ones make ten, ten tens make a hundred, ten hundreds make a thousand and so on. The digit one can be used to represent the numbers

1, 10 or 100 simply by virtue of where it is placed; this is known as place value (Hopkins, Poke and Pepperrell, 2013). Chan, Au and Tang (2013) reviewed the literature available on the importance of place value and concluded that a good grasp of place-value understanding was crucial in learning arithmetic and subpar understanding of place value predicts mathematical difficulties.

In the English language we use two parallel systems for naming numbers which do not always agree with each other. We use a written symbolic system (Arabic numerals – abstract representations of an amount, more often referred to in schools as numbers) and we also use a spoken and written verbal system (words) to say and read our numbers names. These systems conflict with each other and this conflict unfortunately begins early with the 'teen' numerals, so children meet it early in their learning (Tacon, Atkinson and Wing, 2004). For example, most numbers are read forwards like words in a book are, but if you consider the number 13-19 you can see they are irregular.

Children who get "stuck" and are unable to move on with their learning have a poor understanding of place value for 2-digit numbers and showed that there was some confusion when distinguishing between the 'ty' and 'teen' numbers (National Strategies, 2010). This reflects accurately my own experiences and observations discussed in the introduction.

In nearly all cultures the Arabic notation is used, however the way in which the numbers are named is different in each language (van Luit and van der Molen, 2011). Fuson and Kwon (1991) suggest that English speaking children have extra difficulty with some of their

number work compared to Chinese speaking children, as the Chinese number system does not contain the irregularities of the English number system.

Chang, Au and Tang (2014) however found that some children from Hong Kong who speak Chinese and therefore do not particularly experience these irregularities can still lag behind their peers in place-value understanding.

Van Luit and van der Molen (2011) tried to explain to children with moderate learning difficulties an alternative way of naming the numbers. For example, 21 instead of the Dutch conventional way of saying 'One and Twenty' was called two tens and one. They found this approach of naming numbers differently drawing on the Korean way of naming numbers did help children to have some better insight into the number system. Their research, however, also supports Chen and Chang (2005) that simply understanding how numbers are named is not enough to give an adequate understanding of the base-ten number system and place value.

This suggests that it is not only the irregularity of the way the numbers are named but there are other factors as to why some children are behind their peers in terms of place value understanding. Gifford (2005) explains that learning to count and understand numbers includes:

- Visual memory
- Motor co-ordination
- Spatial perception
- Symbolising

Each individual will have different strengths and needs.

Fuson and Wearne (1997) propose that children learn about numbers in a sequence. They called this the UDSSI system.

Table 1: The UDSSI system

The Unitary Stage	unitary multi-digit sequence, no sense that for example 26 is made of 20 and 6.
The Decade Stage	decade and one, children start to see 26 as being made of 10,20, 21, 22,23,24,25,26 but may switch back to count in ones
The Sequence Stage	sequence-tens and ones, e.g. 10,20,30. 40. 41,42,43,44,45,
The Separate Stage	separate-tens and ones, counts 1,2,3,4,5 tens and 1,2,3,4 units and puts together to say 54
The Integrated Stage	children can switch easily between the sequence and separate stages

Bender, (2013) writes of the importance of using manipulatives or concrete examples to help children move from concrete or representational learning to abstract learning.

To follow is a list of the practical or concrete/representational resources I have found available to teachers to help children learn about the number system.

Table 2: Resources available to support the understanding of place value

Place Value arrow cards*	Hundred squares*	Base 10 apparatus*
Counting sticks*	Bead strings*	Interactive Teaching Programmes(ITP) bead strings*
Fully marked number lines*	Partially empty number lines*	Empty number lines*
Flip Stands	Cuisenaire rods	Place value dice
Abacus	Numicon tiles+	Dienes

+Numicon apparatus represents numbers in the concrete form of plastic tiles. Tacon, Atkinson and Wing (2004) developed the Numicon resources. They found that children whose arithmetic had been supported using structured imagery during their research

project in 1998 showed a dramatic improvement in attainment compared to a previous cohort that had not in 1997.

5. The reported advantages / disadvantages of using storytelling as a pedagogical approach to teaching in primary schools?

The following quote from Pound (2010 p66) sums up my own experiences of storytelling.

> "*The vivid visual imagery that good stories create in our minds stimulates our emotions, engages our interest and creates an environment in the brain that is conducive to learning ... simply say to a group of adults (or children) that you are going to tell them a story and they relax into comfortable listening mode".*

Daniel, (2012) reports that our brains have evolved to respond to stories.

Parkinson (2010) reviewed the literature on the reported benefits associated with using stories and/or story structure. To follow are the main benefits he found:

- improves comprehension and logical thinking;
- enhances meaning and memory;
- creates motivation and enthusiasm for learning;
- creates involvement and a sense of community;

Following to a review of the literature around the success of storytelling, Haven (2007, cited in Parkinson 2010 page 8) is quoted as summarising;

> "*The mind-boggling and extraordinary truth is that each and every one of these thousands of independent sources agrees with the premise that stories work, that*

they are effective and efficient. I could not find one shred of evidence to suggest that stories are not effective vehicles to teach, to inspire, to inform, to educate."

Kieran Egan (2010) a Canadian educationalist is a prominent author in the area of storytelling and creative education. He has believed for decades that children will engage with new ideas more readily if they are presented in the form of stories.

4.1 Some examples of successes of storytelling in mathematics education to date

Zazkis and Liljedahl (2009) explored the benefits to students in teaching mathematics as storytelling. They found that through stories, mathematics can become more accessible, engaging to students and may reduce anxiety. They suggest that there are benefits to telling learners how we know things, that someone not too dissimilar to us, made it, invented it or discovered it and why they did it.

Elia et al (2010) completed a small scale study of the cognitive engagement of children aged 5 years old when they listened to a story that had been written to convey a mathematical concept. They found that children were without doubt engaged when they were just read the story but suggest that when the reader asks questions then the engagement and learning is greater.

As a result of her interest in the work of Kieran Egan (1989), Lee in 2002 set up a Theatre Company called MakeBelieve Arts and created the package 'Dramatic Mathematics' (Lee, 2003). A case study referred to in Pound and Lee (2010) talks of the success and benefits of maths taught through storytelling.

McGuire and Kenzie (2013) highlight in an exploratory research project in America with children aged 4-5 years old who were introduced to two-digit numbers. They found that the

children began to show some understanding. They stress that it is important that if children this age are to learn about place value then the pedagogical strategies for the teachers should be clear and allow for them to introduce place value in a meaningful, developmentally appropriate manner. This study used 'physical objects' (structured apparatus) and a story book in its methodology.

I believe that I have found there is justification for my study. The following investigation looks at a pedagogical approach to learning about our number system that is multi-sensory. It combines looking at the irregular naming of some numbers in our number system, visual structured images and manipulatives. The investigation is completed through storytelling which is known to help provide a relaxing learning environment wherein children are motivated to learn. Storytelling is also know to increase meaning and memory.

The next section will explain the methodology for the research project.

Research methodology

In this section I will write about:

1. How the literature review was completed.
2. How the research design was decided upon.
3. The steps taken to maximize the trustworthiness of the project.
4. The ethical considerations of this study.

1. How the literature review was completed

A wide variety of databases were consulted. This included the Birmingham City University (BCU) online library, Educational Resource Information Centre (ERIC), British Education Index, The Evidence for Policy and Practice Information and Co-ordinating Centre (EPPI) and the Economic and Social Research Centre (ESRC) UK Centre for Evidence Based Policy and Practice. The library at the Centre for Research into Early Childhood (CREC) and the main Birmingham City Centre Library were also utilised. In addition government websites such as the National Strategies Archive website were searched for relevant policy documents. My keywords were; pedagogical, mathematics, numeracy, storytelling, stories, children, education, stories, books.

Pertinent items were recorded in a Literature Review Matrix (see example in appendix 1). I found this method invaluable - especially for articles found online, as the hyperlinks could be saved. Labelling each item of literature as A, B or C helped remind me which items were more pertinent than others.

2. The research design

My initial proposal was based around doing a case study with an experimental design (Robson, 2011). I wanted to assess what children knew at the beginning of the study, then

have 7-10 weeks of intervention and then assess what children knew at the end. This would have produced mainly quantitative data. However, when I reflected on my research question, I realised that as this was an area to be explored. I wanted to know not only if a different pedagogical approach worked but why it might work. I realised that operating within the qualitative paradigm would bring about the most interesting insights and suggestions for further research. A work-based (field) evaluative case study was decided upon, using a mixed methods approach (Denscombe, 2010).

The methods of data collection used were mainly observations and questionnaires (see page 21 for more details). In addition the Numicon Diagnostic Assessment was used to measure progress in learning (Tacon, Atkinson and Wing, 2004). This is a tool that is part of the Numicon Closing the Gap Intervention programme. The Diagnostic Assessment is completed at the start of the programme to assess what children know already and it also helps reveal any misconceptions they may have about the number system and calculating.

Despite feeling a little uncertain about gathering qualitative data, I felt the qualitative data gathered would be manageable within this small scale study. Robson (2011) shares that the interpretation of qualitative data can be criticised as it can be subjective. He also explains that it is difficult to remain objective if you are both the researcher and the work-based practitioner involved in the phenomenon of study.

Some wider reading on the issues of trustworthiness (Lincoln and Guba, 1985, Shenton, 2004, Denscombe, 2003, Stake, 1995 and Geertz 1973), enabled me to understand that if

the right research tools and support are in place my research study could be viewed as trustworthy.

3. Steps taken to maximise trustworthiness

Lincoln and Guba (1985) identified four criteria to maximise trustworthiness. These are credibility, transferability, dependability, confirmability. These criteria were considered when planning the project.

Table 3: Steps taken to improve trustworthiness

Criteria	**Sub-criteria**	**Steps taken improve trustworthiness**
Credibility	Prolonged contact	This was a work based study; I had already spent time with the children and staff beforehand.
	Triangu-lation	A core group was set up. This included the Assistant Head teacher, the class teacher, my CREC tutor and the Math's Consultant for the Local Authority. They agreed that I could 'check in' with them. To show if children had made progress in their understanding of the number system after completing the study, an entry and an exit Assessment was completed. To include another measure of progress the teacher-assessed Average Point Score (APS) and the child's Standard Assessment Test (SAT) scores were also included in the data analysis.
	Random sampling	A totally random sample was not a possibility as there were three criteria for selection. These were that the children should be in Key Stage One, struggling with the issue of place value and/or the 'ty' and 'teen' numbers and underachieving in mathematics ability. Average Point Score (APS) data was used to determine whether a child was underachieving. For example, according to the 'The National ruler for measuring children' (see appendix 9) the APS score for a child in Year 2 in the spring term for numeracy is 14. So any score below this was taken as underachieving. After looking at the data, 10 possible children were identified. Then 4 of these were selected at random by picking their names out of a hat. The four children selected were all boys.
	Peer debriefing	Simply sharing details of practice with peers can lead to a researcher having their vision widened, flaws can be identified and alternative research methods suggested (Shenton, 2004). I was able to debrief to members of the Core Group at our Numeracy Working Group meetings. I was also part of a learning community of fellow CREC students.
Transferability	Thick Description	Including a thick description of your setting can allow other research practitioners to get a clearer idea of whether they may be able to achieve similar results in their own setting (Geertz, 1973). To follow is a description of the setting:

		The management team at the school I work at have always been supportive of practitioners completing research studies within the school. The parents of children have been supportive too. It therefore made sense to complete the research where I work. The school is a two-form entry primary school in an urban area in the West Midlands, UK. The children involved in the study were from Year 2 (age 6-7 years old). Standard Assessment Tests (SATs) levels are not below the expected range for Numeracy in Key Stage One. The school has below national average numbers of children that are classified as Special Educational Needs (SEN), English as an additional Language (EAL) and children who have Free School Meals (FSM).
Dependability	Inquiry audit	I made regular entries into a Learning Journal. I wrote not only about what I had done but decisions I had made and why. Writing a Learning Journal allows for others interested in the case study or those who may wish to interrogate the dependability of the study access to key information about how the research unfolded (Stanton, 2004).
Confirmability	In order to bring in other peoples points of view and not just my own the following 'tools' were put in place. •**Questionnaires –** questionnaires were completed by parents, children and the children's class teacher. I used the questionnaires that were utilised in the national Numbers Count Programme (Edge Hill University, 2011). The information I wanted to gather was the same and so it seemed a good idea to use a questionnaire that had already been used nationally. The questionnaire for children used a set of simply phrased, structured closed questions and had wording, Very Happy, Happy, OK, Sad, Very Sad to explain the answers (Robson, 2011). The questionnaires for parents and teachers had a Likert scale of 1 – 5 for participants to tick (1 was never true and 5 was always true) Robson, (2011). Master copies of the questionnaires can be found in appendix 7. •**Researcher session evaluations** – For each session I had a lesson plan with space next to each section to write observations about the children (see appendix 2). I would reflect on the session and document at the end of each session What Went Well (the WWWs) and also the Even Better Ifs (the EBIs). •**Child session evaluations** - at the end of each session I wanted to confirm how the experience had been for the children. I produced a scale of 1- 5 based on the same scale used in the questionnaire (appendix 3). At the end of each session children were asked a question that required them to reflect on the session. They then had to place a picture of themselves on the scale of 1 to 5. A mean value for each session and for each child were calculated. •**Study evaluations -** at the end of the intervention children had the opportunity to reflect on the study as a whole in a semi-structured interview. I wrote down the children's comments then later summarised these into the different categories of WWW's and EBIs.	

4. Ethics

Ethical considerations must take priority when dealing with any research. I completed the Birmingham City University Ethics Approval form prior to starting the study (see appendix 4). The form was completed with consideration of the draft guidelines of the European

Early Childhood Education Research Association (EECERA) Ethical Code for Early Childhood Researchers. To follow are the main ethical considerations identified.

- A leaflet containing information about the project was sent home to parents. It stated very clearly in the leaflet that they did not have to agree to take part, and that they could stop at any time (appendix 5).
- Only 4 of the 10 children that were highlighted as possible participants for the study could join the group. To have a group of 10 children though would have been difficult to manage in terms of behavior, resources and data collection/analysis.
- Was it fair that the children would sometimes be missing part of an afternoon lesson or an assembly? The children involved in the study were already used to being taken out of class to take part in other intervention programs, such as extra reading.
- I produced a script to work from when I invited children to join the study (appendix 6). This meant that I could be sure to give them all the relevant information. Children then signed that they would like to be part of the study and had to tick that I had given them the relevant information. Children knew that they did not have to be part of the study and that they could choose to stop at any time. They were told who they could speak to if they had a problem.
- The children were referred to as Child A, B, C and D to ensure anonymity.
- Part of the research methodology involved children reflecting on each session. Consistent judgments of 'sad' would have been referred to a member of the core group.
- Notes / assessments were kept in a folder in a secure location.

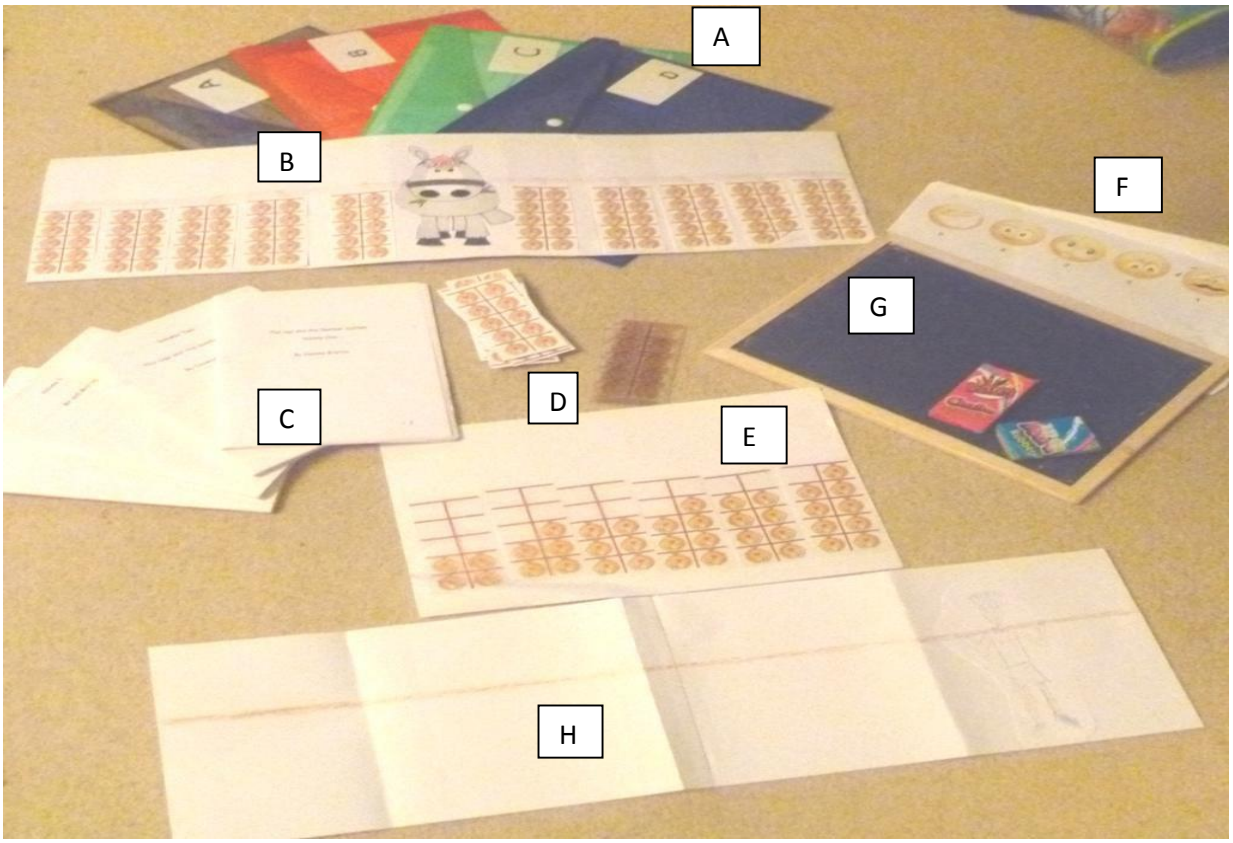
- To debrief the parents involved in the study I wrote a final summarising comment in a thank you card and also invited them in to talk to me. Parents were informed at the start and end of the study that they could request a copy of my research findings.

The next section will summarise how the investigation was completed.

THE INVESTIGATION

Before the intervention started I spent a lot of time writing a series of short stories and illustrating them too. I also designed a set of cards with structured visual images for the amounts 1 -10. Please see below for examples.

Photo A: A photo of some of the resources used.



A – packs for each child

B - the hundred horse carrying 10 ty bars, 100 fish

C – some of the stories typed up and illustrated; volumes 1,2,3 and 4

D – the ty bars

E – the amounts 4-9 for the unit bar

F – the session evaluation tool

G – the chalk boards used

H – the empty fishing rod, ready to be loaded up with ty bars

Four 7 year old boys were taken three times a week, every week for a period of 10 weeks to take part in the intervention programme. Each session lasted 15 - 20 minutes.

In the first week the children filled in the questionnaire (appendix 7). Questionnaires were also completed for each child by their class teacher. Two copies of the parent's questionnaire were sent home to each child (appendix 7). Each child also completed a Diagnostic Assessment. Then lesson plans were written (see example appendix 2). These lesson plans included:

- A mental and oral starter - usually counting or number facts.
- A story - the outline of the story had been planned beforehand by me to convey either a maths concept or a setting for a problem to be solved. The same characters – The Ug Family – were used in each of the stories. I would always stick to the outline of the story that I had planned but the children would contribute to the story with ideas of what the characters might say, how they might have felt and they provided suitable sound effects. See below for two examples of the stories used.
- Approximately five minutes before the end of each session children would either, use and apply the concept that had been presented or solve the problem that had been presented at the end of the story.
- At the end of each session the children were asked to reflect on the session using the reflective tool mentioned in the methodology (see appendix 3).
- After the session, my observation notes were expanded upon.
- Finally, the next session was planned reflecting on what we had learnt so far and what we still needed to learn.

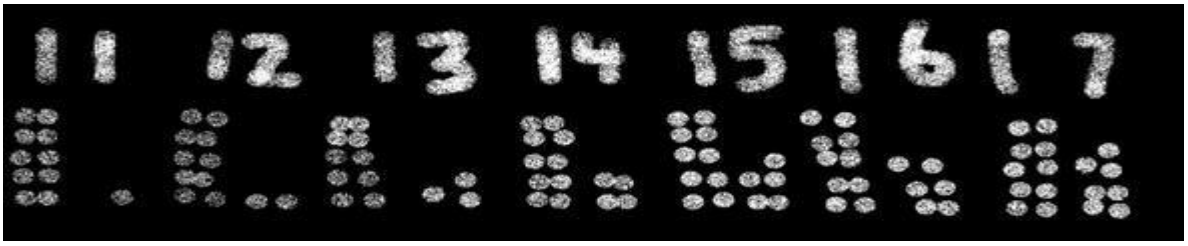
During week 9 children were asked to complete the Diagnostic Assessment again and to answer the questionnaire again. The class teacher completed the questionnaires again.

Upon completion of the 10 weeks of intervention, the children were interviewed as a group by me in a semi-structured format. They were thanked for their time.

Examples of stories

Example one In session 7, we listened to a story about how the teen numbers got their names. In this story Mrs Ug had drawn the number patterns for each of the amounts from 11-19 on the cave wall.

Picture B: The teen numbers in a visual structured image.



When her brother came over they decided to name the amounts. They start off thinking of new names for amounts, eleven and twelve but find it hard going thinking of new names each time. Uncle Ug, is stood by the amount that shows 19, he suggests they use the number names they have already made up and call it 'nine ten', he then walks down the line seeing next 'eight ten'. Mrs Ug thinks this is a great idea and is very happy and smiley so when she repeats these names she pronounces them more like nineteen, eighteen. They continue down the line, seeing the unit amount first then the ten. When they get to 15, as they name it, Uncle Ug hiccups and so they call it "f-i-f-teen", when they go to name the amount 13, Larry the smelly revolting, three eyed, three legged lizard walks past and makes them say "th-urgh-teen". They talk about renaming 12, "twoteen" and 11, "oneteen" but decide against it. At the end of the session the children practiced counting to 19. Also they practiced saying the numbers 11 – 19 in response to seeing a visual image. Then they counted backwards from 19 too.

Example two In session 22, a customer came to the Ug family's fish stall and ordered 32 fish. The children helped to describe the character. She then asks for another one full ty bar – ten fish. The children listened to how Mrs Ug worked it out and looked at a visual image for 32+10=42. The children later had to help Chaz – the son – who has to serve the same customer the following week. The customer orders 42 fish and then changes his mind and asks for another 10.

Results – analysis of data

The analysis of the data collected was divided into qualitative and quantitative data:

1. Quantitative Data
   1.1 Children's attainment and progress
   1.2 Responses to questionnaires –children; teacher; parent
2. Qualitative Data

2.1 My reflections summarised from my Learning Journey.

2.2 My observations and details of WWW's and the EBI's summarised from each sessions evaluative reflective tool.

2.3 A summary of the children's WWWs and EBIs at the end of the intervention during in a semi-structured interview.

2.4 Responses from children after each session.

1.1 Children's attainment and progress

Each child's APS and their teacher assessed numeracy level were noted before and after the intervention. I was also able to access their Standard Assessment Test (SAT) level.

Table 4: Children's attainment

	APS Score		Teacher assessed level		SAT Level
	Pre	Post	Pre	Post	
Child A	11	13	1b	2c	2b
Child B	14	15	2c	2b	2b
Child C	10	12	1c	1a	no data - child absent
Child D	11	13	1b	2c	2b

The national ruler for assessing children's progress (see appendix 9) states that in spring term a Year 2 child should have an expected APS score of 14 and should progress to 16 by

the end of the academic year. Therefore, with exception of child B, all these children could be seen as underachieving in mathematics. Child B was included in the study as he had been flagged up as a child that had not made progress since the beginning of the academic year and seemed not to have a secure understanding of place value.

These results show that the children did make progress during the intervention. It is of course possible that they would have made this progress anyway without the intervention programme. The data in Table 4 shows their overall progress across the range of numeracy skills for example this includes progress they have made learning about shape and measuring.

To track the progress they made on the areas of numeracy the intervention focussed upon, I completed the Numicon Diagnostic Assessment (Tacon, Atkinson and Wing, 2004) pre and post intervention. The results are on the following page (Table 5).

Table 5: Results of the Numicon Diagnostic Tests

- Means they were not tested on the post intervention assessment as they had already achieved this

	Counting Range		Counting backwards: Range		Counting in 2s		Counting in 5's		Counting in 10s		Step counting in 10's		Counting objects		Conservation of number		Recognising and naming numerals: Range		Ordering numerals :Range		Say in between numbers: Range		Writing numbers	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Child A	29	116	0	20	12	20	0	10	40	100	0	0	10	27	Yes	-	100	-	34	72	21	72	100	100
Child B	59	109	10	24	20	-	50	-	100	-	-	106	27	-	Yes	-	100	-	11	72	21	72	16	100
Child C	109	109	10	24	20	-	50	-	100	-	-	106	13	27	Yes	-	100	-	21	34	21	34	18	100
Child D	100	139	10	24	20	-	50	-	100	-	-	96	30	-	No	Yes	100	-	10	72	21	72	100	100

	Making two digit numbers with apparatus and knowing the value						Use place value to calculate 10 more		Adding two digit numbers together		Saying how many in response to an amount			
	17		23		32						13		35	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Child A	No	Yes	No	Yes	No	Yes	No	Yes	No	No	No	Yes	No	Yes
Child B	Yes	-	Yes	-	Yes	-	No	Yes	No	Yes	No	Yes	No	Yes
Child C	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Child D	No	No	Yes	Yes	Yes	Yes	No	almost	No	No	No	Yes	No	Yes

Both Child A and B extended their counting range. Child A still hesitated at each of the boundaries, where the number crossed to the next decade. I observed that each time he reached a boundary, for example 59, 60 he would pause and then look into the corner of the room. Child A, later said "I was trying to imagine the amount and how it changes when you add one." Child B counted faultlessly to 109, after 109 he thought for a while and then said "tenhundred" in a questioning voice. Even though he said it incorrectly I felt this was progress, as previously after 109, he would always say "200,300, 400". I believe that both these children were remembering parts of the story or trying to recall the visual images that had been presented during the intervention.

All children had made progress in their ability to count backwards. When I praised Child C after he had counted backwards from 29, he said he was "imaging walking down the number line."

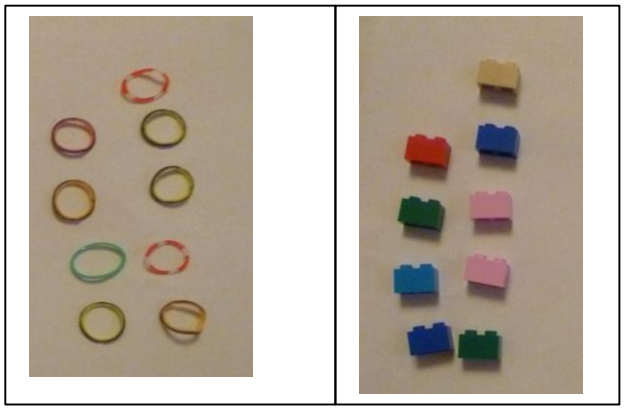
Child A could count in 2's by the end of the programme and was close to mastering counting in 5's. I observed that previously when Child A had counted in 2's he seemed to be reciting it like a poem and got stuck after 12. Possibly using his working memory only (see Miller, 1956) After the intervention I observed him whispering the numbers to himself missing out each alternate number showing he was now counting with understanding. This relates to the point Dolya, 2009 makes that quality not quantity is important.

Child A also progressed in his ability to count in 10's, previously he had missed out 50 in the count sequence and after 90 he had said 20. Child A initially did not always very clearly articulate clearly if a number was nineteen or ninety. However, it was noticeable during the post intervention assessment that when he was counting that he was articulating the "teen" part of the numbers. This was a strategy we had done as part of the intervention

programme. We had referred to the 'teen' numbers as the smiley numbers. It is possible now that these numbers were not just abstract to him. That now he had a visual image for them, and a story about how and why we say that number (see Zazkis and Liljedahl, 2009).

Child D previously had not mastered conservation of number, but by the end of the intervention he had. At the beginning of the intervention programme we would practice counting objects by grouping them into tens. I was able to target Child D in this activity and we explored that even though we changed some objects around there were always still the same amount. I believe having the objects arranged in a structured image helped this child understand the quantity stayed the same. An example of the number pattern or visual structured image for 9 would be:

Picture C: A structured visual image for 9



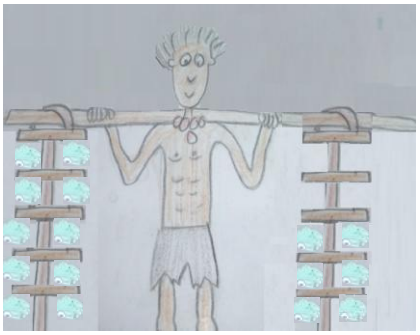
Child A, who was initially unable to count past 30, was able to order the numbers 66 – 74. Part of the assessment included children ordering the numbers and then one card is turned over whilst they close their eyes. Child A was able to say that the hidden number was 66. He said he had noticed the pattern that it was going, 9, 8, 7 (whilst pointing to the unit number) and so he knew the next one must be 6. He said he was imagining "how they numbers were named".

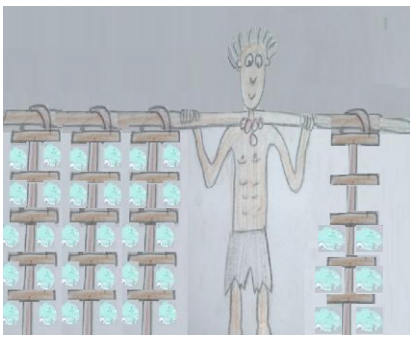
The children made progress in their ability to see 3 groups of 10 and 5 and know that this is 35. Child A, C and D did not feel the need to count up in ones which they had previously. This suggests they had all moved from the Unitary Stage and were either operating at the Sequence Stage or the Separate Stage, (Fuson and Wearne, 1997). Child A and Child D were not secure when presented with 13 as one group of ten and 3 but they did both answer correctly. Child A used his finger to write the value of the amounts underneath and then said "Oh it's 13."

All children could make a given amount such as 32 using practical apparatus. Child D, initially made 32 using a 3 numicon tile and a 2 numicon tile but without prompting quickly realised "there's not enough here to be 32". This seemed to show to me that he was beginning to get a feel for numbers.

All children were then able to say what 10 more than the amount they had just made was. Child B, C and D could also step count in 10s (for example, 6,16,26,36.) All children had previously been unable to step count in tens. We practiced step counting in 10s using a power point slide show of the images.

Picture D: Images for step counting in 10's

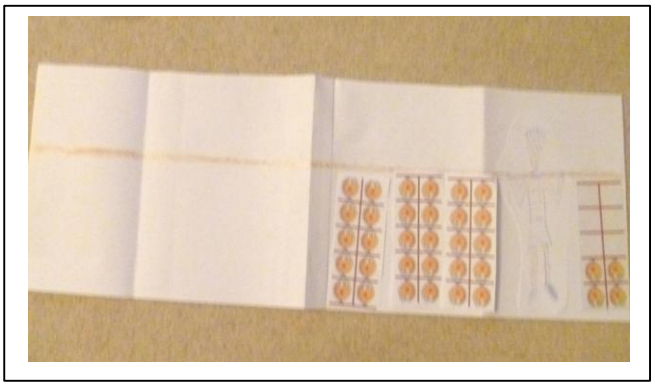




Child B knew that 106 comes after 96 and after that he said “a hundred and ten and six” but he could not say this was ‘one hundred and sixteen’ but I felt this showed a progressive understanding of the place value system.

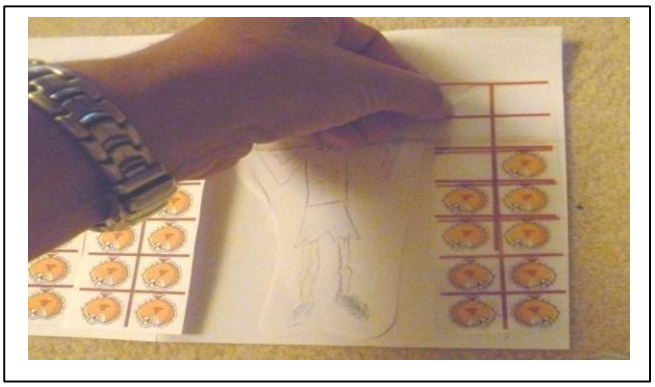
Child B and C were able to use practical apparatus to make two amounts such as 34 and 35 and combine them to make 69. Child D made a mistake when he was calculating. However, when I presented him with a drawing of Mr Ug and his ty bar (which we had used in the sessions) and asked him to load his ‘ty’ bars onto the fishing pole he was able to then give the answer.

Figure E: Image of the steps taken to add 34+35



Load the Ty bar with 3 tys and 4

Get a further 3tys and 5



Add the units together first

Finally, add the full ty bars

1.2 Responses to questionnaires

The following section presents the results and the analysis of three different questionnaires completed during the study.

Table 6: Children's responses to questionnaires

	How do you feel about going to school?		How do you feel about numeracy lessons?		How good do you feel you are at mathematics?		How good do you feel your teacher thinks you are at mathematics?	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Child A	 1	 5	 5	 4	 1	 5	 5	 4
Child B	 4	 3	 2	 4	 5	 5	 1	 5
Child C	 4	 3	 3	 4	 5	 5	 1	 4
Child D	 3	 5	 2	 5	 4	 5	 1	 5

It was interesting to note that initially Child B, C and D pointed to the face that showed they felt very happy or happy when asked "How good do you feel you are at mathematics?" They then however, proceeded to point to the face that showed "Very Sad" in response to the question "How good do you feel your teacher thinks you are at mathematics?" This suggested that they had quite high self-esteem in relation to mathematics, but this is in conflict with the view they have of what they think their teacher believes.

Child A felt that he was not good at mathematics, however, he felt that his teacher thought he was very good. This is another conflicting self-image.

It was interesting to see that their attitude post intervention changed. That they gained in confidence seemingly not just in themselves but in how their teacher sees them. This supports the view that most interventions will be successful as you can help build confidence (Lawrence, 2006). Furthermore, it could suggest that the specific praise used throughout the intervention programme helped the children to come to a self-image that was more consistent. The children were praised for the steps they had taken to solve a problem rather than praising their success or giving comforting feedback if they were incorrect (Ratten, Good and Dweck, 2012).

Table 7: Teacher's responses to questionnaire

	S/he takes an active part in mathematics lessons.		S/he can think of more than one way to work things out.		S/he is prepared to have a go even if s/he is not sure.		S/he can explain how s/he worked things out.	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Child A	2	3	1	1	1	2	2	2
Child B	1	1	1	1	1	2	2	2
Child C	3	4	2	2	3	4	2	2
Child D	3	4	2	2	3	5	3	3
1 = Never True, 2 = Rarely True, 3=Sometimes True, 4=Mostly True, 5=Always True								

I believe this information shows that the teacher's opinion had only changed with regards to the statement "S/he is prepared to have a go even if s/he is not sure." The teacher's opinion had changed for each child. It is possible that what had changed for the children is that during the intervention they had regularly seen a character/ a role model who

made mistakes and we talked regularly in our group about how it is OK to make mistakes. The children would enjoy correcting the mistakes that the characters in the stories made and reflecting on why the character might have made that mistake. It cannot be proven that this change in the children was a result of the intervention as there are other variables. However, because all four experienced a change, I believe it is likely the intervention did have an influence. This supports the constructivist theory of learning that children learn through their experiences and from having the opportunity to reflect on their experiences. It also supports Vygotsky (1966) that children learn when a "more knowledgeable other" is present. There were parts of the stories where children had the opportunity to hear the 'internal thoughts' of the main character and therefore experienced how someone else had thought a problem through. They had seen the human tool of language in use and being used to model higher order thinking. The children were also given regular opportunities to practice and use and apply what they experienced which links to Lave and Wenger's Situated Learning theory (Lave and Wenger 1991).

Table 8: Parent's responses to questionnaires

	S/he likes to talk about numbers and mathe-matics in everyday situations	S/he tells me about the mathematic s s/he is learning at school.	I like to help her/him to learn mathe-matics	I know how to help my child improve his/her mathe-matics	I had a positive experience of mathe-matics at school.	I have a positive attitude towards mathe-matics
Child A	3	2	4	4	Agree	Strongly Agree
Child A	1	1	5	4	Disagree	Agree
Child B	3	2	4	4	Agree	Strongly Agree
Child D	4	5	5	5	Agree	Strongly Agree

NB Child C did not return any questionnaires, Child B and D only returned one questionnaire each.

It is interesting to note that the mother of Child A is the only one out of three that disagreed that they had a positive experience of mathematics. This is in contrast to what I personally believed the results would show after reading the literature such as the Williams Review (DCSF, 2008). Also, it is interesting to note that it is also only Child A who has a low self-image of his mathematics. This supports Jones (2014) that there is a link between how a parent feels about mathematics and their child's self-image.

I chose not to repeat the questionnaires post intervention as I did not feel they would give any new information. This is because the communication with parents was not completed as frequently as I initially planned. Before the intervention I had written and illustrated some stories in a series of short books. There were 14 short stories and at the end of each story were some ideas of things parents can do at home to help support their child's numeracy development. I had decided to organise these stories into 4 volumes and to send one volume home at a time. In the first few weeks, a pack containing one of my books or a numeracy-related, published book from our library area was sent home. However, as time went on changes in my work commitments meant I could not always be certain which days of the week I would be able to do the sessions on. Therefore, the packs were in school less frequently on the right days. I have to admit myself to often not having time to write in the learning diary and organise a book to go home too. The inconsistent communication with parents is one of my biggest disappointments as I think that this could have been an interesting area to explore.

2.1. A summary of my reflections in my learning journey

I feel that I grew in confidence as a practitioner as time went on. I had been disappointed that the Advanced Storyteller course I had booked onto had been cancelled.

One of my highlights was at the end of one session asking "How do you feel about your learning today?" and the children looked at me with a slightly puzzled expression, and one of them actually said "What learning?" In this session the children had enjoyed playing with cut out puppets of the characters and re-enacting one of the stories where the 'teen' numbers were named (walking backwards down the number line). They had not felt like they had learnt anything. It is my opinion that they had because before the intervention not one of them could count backwards from 29 but after these sessions they could. This links to Whalley (2007) that children learn best when they are intrinsically motivated.

3.2 A summary of the WWWs and the EBIs I recorded after sessions on the session planning /evaluation sheets

WWWs	EBIs
• The more I retold some of the stories, the more confident I became. • Getting children to provide sound effects to the stories. • Child A talked about reading his book at home (to himself). • Keeping all the documents and resources in one box helped.	• Quite often sessions were late starting so the already brief time slot of 20 minutes during assembly was reduced to more like 15. • The environment we worked in could quite often be noisy. • I would sometimes feel self-conscious if another staff member was listening to our session. • Role play was difficult to do because the boys were reluctant to be a female character. • When the story was intentionally a bit funny, the children did tend to get a bit 'silly'.

2.3 A summary of the children's WWWs and EBIs at the end of the intervention during in a semi-structured interview.

WWW

- The children liked the characters, particularly the naughty monkey and the smelly lizard.
- They reported that they did not mind missing assembly.
- They liked that the main character Mrs Ug kept making mistakes, and they enjoyed when her brother kept correcting her or they would correct her themselves.
- They liked using the chalk boards.
- They liked the pictures. They particularly liked one picture and requested to see it over and over again.
- They liked that they could bring their own ideas into the stories. For example, Child C suggested there could be an Auntie or a Granddad.

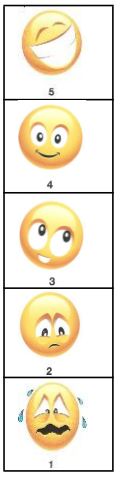
EBIs

- They could not always finish their task as the bell would go for play time.
- The chalk sometimes snapped.
- Child B said he would like to have used number cards more.
- Child C said he could not always see the computer screen really well.
- Child D said he would have liked more "proper" books to take home. He had enjoyed 'How Big is A Million?' by Anna Millbourn.
- Child A said he did not like it when we did not get to play with the naughty monkey.
- Child C said it would be even better if he could "do group everyday".

2.4. Children's session evaluations

Table 9: Children's responses at the end of each session

Session	Child A	Child B	Child C	Child D	Mean
2	5	5	5	1	5
3	5	5	5	1	5
4	5	1	5	5	5
5	5	4	5	5	5
6	5	5	5	5	5
7	5	5	2	5	5
8	5	5	Absent	5	5
9	5	5	Absent	5	5
10	5	4	5	5	5
11	5	5	5	5	5
12	5	5	5	5	5
13	5	5	5	5	5
14	5	5	5	5	5
15	5	5	5	5	5
16	5	5	5	5	5
17	5	5	5	5	5
18	5	5	5	5	5
19	5	5	5	5	5
20	5	5	5	5	5
21	5	5	5	5	5
22	5	4	5	5	5
Mean	5	5	5	5	5



At the end of each of the sessions the children were asked to either point to or place a photo of themselves onto a scale of 1-5 in response to a question. The question asked was a variation of “How do you feel about your learning today?”

The results suggest that the children felt positive about the sessions. Goleman (1999) believes that children will learn better if they are not stressed as they are then able to use the frontal lobes of the brain which are the areas required for learning and understanding. Therefore in my opinion these sessions provided a good learning environment. I believe the children’s reflections coincide with my observations too. Our group time was something we looked forward to.

When I was debriefing to members of my core group at school, one member enquired whether the children felt positive about their learning because I was not providing them with challenging work. My response to this was the investigation was not about providing challenging work and getting the children to make the maximum progress. It was about exploring the area as a possible pedagogical strategy.

CONCLUSION

The research question was to explore how storytelling and structured visual images might be used as a pedagogical strategy by practitioners in furthering the understanding of the English number system for children in Key Stage One who are underachieving in mathematics. I believe that combining storytelling with a structured visual image in this case study was a successful pedagogical approach. The children made progress in their learning. They were motivated and engaged in their learning. It would seem that the children used parts of the stories and the accompanying structured visual images to help them recall information. The children experienced that it is OK to make mistakes and the teacher reported they were more likely to have a go at things in maths lessons if they were not sure.

It is of course not possible to confirm whether the children would have made progress anyway simply through their daily mathematics classes. If four children had been taken to do any kind of maths intervention using different place value resources you would hope to see progression, over a 10 week period, regardless of the resources used. However, during the exit assessment the children made comments which would suggest they were remembering something from the intervention. For example, when Child C said he was imagining walking down the number line when he was counting backwards from 29.

It would be interesting to investigate whether another practitioner would be able to run a similar intervention group using the same resources. I would hypothesis though that the success of the pedagogical approach will be influenced by the personal qualities of the lead person - their enthusiasm, their creativity, their willingness to allow children to be equally

creative, their willingness to let children record their thoughts in their own way and their own view on mathematic education.

Additionally since this study looked at the combined approach of both storytelling and structured visual images together, it is not possible to say whether it was the combined approach or maybe just the storytelling or structured visual images that were valuable. It would be interesting to find out whether simply providing a structured visual image when children are counting would be an effective pedagogical tool. This could be in the format of a power point presentation like I had done – see page 32. I have never seen this done in school before and could not find a similar resource online.

The resources used in the intervention were adequate for an exploration into the area. However, if further research were to be done it would be beneficial to improve these. This could be done by utilizing the skills of an illustrator to brighten up the story books and the skills of an experienced children's author to improve the readability of the written stories.

As previously mentioned changes to the new National Curriculum Mathematics Programme (Department for Education, 2013; DFE-00180-2013) will mean children will be expected to learn even more, even younger. McGuire and Kenzie (2013) found that it is important that if children are to learn about place value then the pedagogical strategies for the teachers should be clear and allow for them to introduce place value in a meaningful, developmentally appropriate manner. It is possible a storytelling approach using structured visual images might be a useful pedagogical strategy to introduce young children to the number system or also to help those children that have failed to learn through conventional teaching methods.

REFERENCES

Askew, P. (2010) In: Thompson, I., ed. *Issues In Teaching Numeracy In Primary Schools. [online].* Open University Press. Available from:<http://www.myilibrary.com?ID=333885> 10 January 2014.

Bandura, (1925) In: Pritchard, A. and Woolard, J. (2013). *Psychology for the Classroom: the Social Context. London:* Routledge. *[Available on-line]* <http://www.myilibrary.com?ID=258966> (accessed 12th February 2014).

Bassey et al (2014) L*etter to Independent expressions of concern too much too young*. Independent News, [online]. 20 March 2014. Available at: http://www.independent.co.uk/voices/letters/letters-gove-will-bury-pupils-in-facts-and-rules-8540741.html [accessed March 2014].

Bender, W. (2013) *Differentiating Mathematics Instruction*. Third Edition. USA: Corwin.

Bruner, (1915) In: Pritchard, A. and Woolard, J. (2013). *Psychology for the Classroom: the Social Context. London:* Routledge. *[Available on-line]* <http://www.myilibrary.com?ID=258966> (accessed 12th February 2014).

Chan, W., Au, T. and Tang, J. (2013) *Strategic* Counting: A novel assessment of place-value understanding. *Learning and Instruction* 29 (2014) 78 – 94.

Chen, Z. J., and Chan, L.K.S (2005) Chinese number-naming advantages? Analyses of Chinese pre-schoolers computational strategies and errors. *International Journal of Early Years Education, 14,* 179-192

Corbin, B. (2008) *Unleashing the potential of the teenage brain. 10 Powerful ideas.* USA: Corwin Press.

Daniel, A. (2012) *Storytelling across the primary curriculum.* Oxon*:* Routledge

Department for children, schools and families, DCSF. (2009). Securing Level 2 in Mathematics. Reference number DCSF, 00687-2009BKT-EN, [accessed on-line January 2014)

Department for Education. (DfE)(2013). *National Curriculum for Numeracy*. Reference number DFE-00180-2013, [Accessed on-line June 2014] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/239129/PRIMARY_national_curriculum_-_Mathematics.pdf

Denscombe, M. (2010) *The Good Research Guide: For Small-Scale Social Research Projects : for small-scale social research projects.* Open University Press.

Dewey, J. (1859-1952) In: Pritchard, A. and Woolard, J. (2013). *Psychology for the Classroom: the Social Context. London:* Routledge. *[Available on-line]* <http://www.myilibrary.com?ID=258966> (accessed 12th February 2014).

Dolya, G. (2009) *Vygotsky in Action in the Early Years: The Key to Learning Curriculum.* Oxon: Taylor & Francis. Available from:<http://www.myilibrary.com?ID=223421> 10 February 2014.

Dweck, C. (2008) Self-theories: Their Role in Motivation, Personality and Development. *The Journal of Child Psychology and Psychiatry and Allied Disciplines*, vol. 41, no. 8, pp. 1077-1084.

Egan, K., and Madej, K. (2010) *Engaging Imagination and Developing Creativity in Education.* Cambridge: Cambridge Scholars Publishing.

Elia, I., Marja van den Heuvel-Panhuizen & Georgiou, A. (2010) The role of pictures in picture books on children's cognitive engagement with mathematics, *European Early Childhood Education Research Journal*, vol. 18, no. 3, pp. 275.

Edge Hill University (2011) Every Child Counts, Numbers Count Programme. Information available at <https://everychildcounts.edgehill.ac.uk/. (Accessed February 2014).

Fuson, K. C. and Kwon, Y. (1991) Chinese-based regular and European irregular systems of number words: The disadvantages for English-speaking children. In K. Durking and B. Shire (Eds.), *Language in mathematical education: Research and practice* (pp.211-226). Milton Keynes, PA: Open University Press.

Fuson, K. C. and Wearne, D. (1997)Children's conceptual structures for multidigit numbers and methods of multidigit addition and subtraction. *Journal for Research in Mathematics Education*, 28 (1997), pp. 130–162

Geertz, C. (1973) *Thick Description: Toward an interpretative theory of culture.* In Geertz, C. *The interpretation of cultures* (pp. 3-30). New York: Basic Books.

Gifford, S. (2005) *Teaching mathematics 3 – 5 developing learning in the foundation stage.* Open University Press McGraw-Hill education.

Goleman, D. (1996) *Emotional Intelligence: Why it Can Matter More Than IQ.* Bloomsbury Publishing PLC

Goleman, D. (1999) *Working with emotional intelligence*. Bloomsbury Publishing PLC

Haven, J. (2007) In Parkinson, R. (2010) *Storytelling and imagination: Beyond Basic Literacy 8-14.* Routledge**.**

Hopkins, C., Pope, A. and Pepperell, S. (2013) *Understanding Primary Mathematics.* David Fulton Publishers.

Jones, W. (2014) *I can't do maths" - if you're saying it, your kids probably are too.* Available at: Mumsnet < http://www.mumsnet.com/Talk/guest_posts/a2024192-Guest-post-I-cant-do-maths-if-youre-saying-it-your-kids-probably-are-too> (Accessed June 2014)

Lave, J. and Wenger, E. (1991) *Situated learning: Legitimate peripheral participation.* Cambridge: Cambridge University Press.

Lawrence, D. (2006) *Enhancing Self Esteem in the classroom.* Sage Publications Ltd.

Lee, T. (2003) Dramatic Mathematics. Available at: MakeBelieveArts <http://www.makebelievearts.co.uk/Information/Resources/item131?startPos> (Accessed March 2014).

Lincoln, Y. S. and Guba, E.G., (1985) *Naturalistic Inquiry.* Newbury Park, CA: Sage Publications. In Shenton, A., (2004) *Strategies for ensuring trustworthiness in qualitative research projects.* Education for Information 22, pages 63-75. IOS Press.

McGuire, P. and Kenzie, M.B. (2013) Analysis of Place Value Instruction and Development in Pre-Kindergarten Mathematics. [accessed online] *Early Childhood Education Journal: 3 (2013) http://www.researchgate.net/publication/257557028_Analysis_of_Place_Value_Instruction_and_Development_in_Pre-Kindergarten_Mathematics [accessed February 2014]*

Milbourne, A. and Rigliette, S. (2007) *How Big is a Million? London:* Usbourne Publications.

Miller, G. (1956) The magical number seven, plus or minus two: Some limits on our capacity for processing information. *Psychological Review*, 63 (1956), pp. 81–97

National Strategies (2010) *Children who get stuck at Level 2c.* Available at: <https://www.learntogether.org.uk/Resources/Documents/Research%20paper%20-%20stuck%20at%202c%20full%20version.pdf> Reference 00258-2010PDF-EN-01(Accessed November 2013)

Parkinson, R. (2010) *Storytelling and imagination: Beyond Basic Literacy 8-14.* Routledge**.**

Piaget, J. (1896-1980) In: Pritchard, A. and Woolard, J. (2013). *Psychology for the Classroom: the Social Context. London:* Routledge. *[Available on-line]* <http://www.myilibrary.com?ID=258966> (accessed 12th February 2014).

Pinczes, E. (2000) *One Hundred Angry Ants.* Houghton Mifflin.

Plass, J. (2010). *Cognitive Load Theory. [online].* Cambridge University Press. Available from:<http://www.myilibrary.com?ID=263135> (Accessed 19 January 2014).

Porkes, R. (2011) *A world class mathematics education for ALL our young people.* Available at: National Numeracy. <http://www.nationalnumeracy.org.uk/resources/15/index.html?> (Accessed December 2011).

Pound, L. and Lee, T. (2010) *Teaching Mathematics Creatively.* Routledge. New York; London.

Pritchard, A. and Woolard, J. (2013) *Psychology for the Classroom: the Social Context. London:* Routledge. *[Available on-line]* <http://www.myilibrary.com?ID=258966> (accessed 12th February 2014).

Rattan, A., Good, C. and Dweck, C. (2012) It's OK – not everyone can be good at maths. ": Instructors with an entity theory comfort (and demotivate) students. *Journal of experimental social psychology*, vol. 48, no. 3, pp. 731-737.

Robson, C. (2011) *Real world research: a resource for users of social research methods in applied settings.* Wiley, Chichester.

Shenton , A., (2004) *Strategies for ensuring trustworthiness in qualitative research projects.* Education for Information 22, pages 63-75. IOS Press.

Stake, R. E., (1995) *The Art of Case Study Research. California:* Sage Publications Inc.

Sunderland, M. (2001) *Using Story Telling as a Therapeutic Tool with Children.* London: Speechmark Publishing Limited.

Tacon, R., Atkinson, R. and Wing, T. (2004) *Learning about numbers through patterns – using structured visual imagery – Numicon – to teach arithmetic.* London: BEAM Education. Available online at <http://fdslive.oup.com/www.oup.com/oxed/primary/maths/numicon/Numicon_research_BEAM_learning_about_numbers.pdf?region=uk> (accessed January 2012).

Thompson, I. (2010*) Issues in Teaching Numeracy In Primary Schools.* New York; Maidenhead: Open University Press.

Torgeson, C.J., Wiggins, A., Torgeson, D.J., Ainsworth, H., Barmby, P., Hewett, C., Jones, K., Hendry, V., Askew, P., Bland, M., Coe, R., Higgins, S., Hodgem, J., Hulme, C., and Tymes, P. (2011) *Every Child Counts: The independent evaluation, Technical Report*. York, Birmingham and Durham: Universities of York, Birmingham and Durham.

Van Luit, J. and Van der Molen, J. (2011). The effectiveness of Korean number naming on insight into numbers in Dutch students with mild intellectual disabilities. *Research in developmental disabilities,* vol. 32, no. 5, pp. 1822-1828.

Vygotsky (1896-1934) In: Pritchard, A. and Woolard, J. (2013). *Psychology for the Classroom: the Social Context. London:* Routledge. *[Available on-line]* <http://www.myilibrary.com?ID=258966> (accessed 12th February 2014).

Vygotsky (1996) In: Pritchard, A. and Woolard, J. (2013). *Psychology for the Classroom: the Social Context. London:* Routledge. *[Available on-line]* <http://www.myilibrary.com?ID=258966> (accessed 12th February 2014).

Whalley, M. & Pen Green Centre (2007) *Involving parents in their children's learning*. Paul Chapman Publishing, London.

Williams, P. (2008) *The Williams Review of Mathematics Teaching in Early Years Settings and Primary Schools. Reference number* DSCF-00443-2008. [accessed online National Numeracy] <http://www.nationalnumeracy.org.uk/resources/16/index.html> (Accessed June 2014).

Zazkis, R. and Liljedahl, P. (2009) *Teaching Mathematics as Storytelling.* Sense Publications. [Accessed online] <https://www.sensepublishers.com/catalogs/bookseries/other-books/teaching-mathematics-as-storytelling/. (Accessed May 2014).

LIST OF APPENDICES

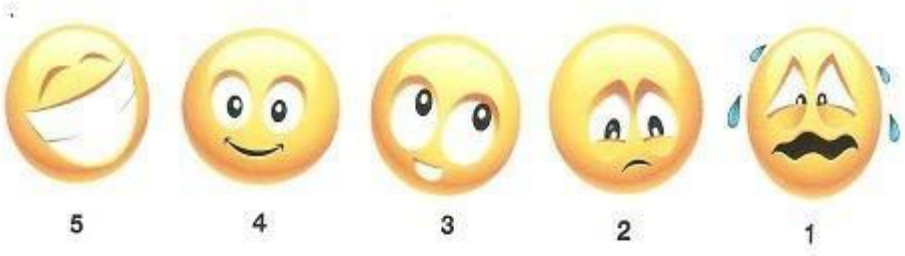
APPENDIX 1 - Example of a page from the Literature Review Framework

ABC	Author	Reference	Brief description
A	Rattan, A, Good, C and Dweck, C (2012)	It's OK – not everyone can be good at maths. Instructors with an entity theory comfort (and demotivate) students. Journal of experimental social psychology, vol. 48, no. 3, pp. 731-737.	The way you view intelligence as either fixed or malleable will influence on how you work with children. Your responses to them by either continuing to challenge them or by comforting them will impact on their behaviour. Those that are comforted will sit back and disengage, those that are challenged and told their intelligence can grow with hard work and effort will succeed.
A	Coles (2011)	Coles, Anthony;McGrath, Jim. 2011., *Your Education Research Project Handbook. [online].* Taylor & Francis. Available from:<http://www.myilibrary.com?ID=253034> 2 March 2014	Important book giving tips and advice e.g. How to change a paragraph in literature review so it sounds more your interpretation but also includes the reference.
B	Skoumpourdi, C. (2010)	Skoumpourdi, C. (2010) Kindergarten mathematics with 'pepe the rabbit; how kindergardtners use auxiliary means to solve problems. European Early Childhood Education Journal. Vol.18, No3, September 2010, 299-307	Notes taken when at CREC see black book. Children using cubes to solve problems need to be taught how to use them first. Giving children auxiliary means doesn't automatically facilitate problem solving. Children in this study showed a preference for using their fingers.
A	Dowker 2004	Dowker 2004 What works well for children with mathematical difficulties the effectiveness of intervention schemes http://webarchive.nationalarchives.gov.uk/20110202093118/http:/nationalstrategies.standards.dcsf.gov.uk/node/174504	WHAT A FIND, this document lists and reviews very many numeracy intervention projects taking place in UK, detailing methodologies, sample sizes and summary results. Gives contact names of people involved. Include preliminary review of talking maths which is very positive. What works well is that children that are underperforming in maths are highly susceptible to targeted and intervention should be done early to avoid negative attitudes developing and to allow access to the rest of the curriculum.

APPENDIX 2 – An example of a lesson plan / evaluation / observation sheet

Session Number 19 Date May 2014	Comments and observations
Circle if attending Child A Child B Child C Child D	
Starter activity looking at visual images on a PowerPoint, get children to count in 10s, step count in 10's, count in 2's, count in 5's and then count to a hundred. Focus on Child A.	
Main Session Story – the Ugs are getting even better at fishing. They swapped some fish with the double bellied giant for some twisted vines which look like rope and they managed to create a huge net. Now they have even more fish than they can carry on the hundred horse, all of Mr Ugs 9ty and 9 on the unit bar, that's 199 fish. (show images) Can the children guess what happens next? They get another hundred horse now they have two hundred horses. They catch more and more fish and then one day a funny looking man comes with a bone through his nose comes to their Sunday shop, he lives on thousand island and he wants enough fish for everyone on the island. He brings 10 horses with him and they fill up his 10 hundred horses with fish on the ty bars. They load the horses with the fish onto the raft to float over to thousand island. Do you know what they called 10 hundred horses? That's right, a thousand.	Children giggled at the mention of the giant. Child C, said get another horse, Child D, oh yeah 200! Laughed at this Child D, a thousand!
Use and apply How many 10's in hundred How many hundreds in a thousand	
Reflection How to you feel after today's lesson?	Responses Child A Child B Child C Child D
WWW Liked the detail of the bone through the nose. Tried to visualise the images of the 10 horses walking onto the raft.	EBI Rushed session They didn't know what a raft is.

APPENDIX 3 - Example of the child session evaluation sheet. Children either pointed to the picture that matched the way they felt or they placed a photo of themselves next to one of the faces.



APPENDIX 4 - Relevant details taken from Ethics Form

Request for Ethical Approval

Section 1 – to be completed by the researcher

Full name	Deanne Brettle
Module number and title (student researchers only)	MA Double Research Module
Research Proposal title	How might storytelling and structured visual images be used as a pedagogical strategy in furthering the understanding of the English number system for children in Key Stage One who are underachieving in mathematics?
Funding body applying to if applicable	None
Brief outline of proposal (including research questions where appropriate) You are also asked to submit with your application copies of any questionnaires, letters, recruitment material you intend to use if these are available at the time of requesting approval	Research has shown that one of the key things that can stop a child from progressing in numeracy is their inability to understand our Place Value System. A further barrier to progression is that they have difficulty distinguishing between "ty" and "teen" numbers (DCSF, 2009). In the English language we use two parallel systems for naming numbers which don't always agree with each other. We use a written symbolic system (numerals) and we also use a spoken and written verbal system (words) to say and read our number names. These systems conflict with each other. Some children are able to overcome these irregularities but for others it seems harder to grasp. I want to explore whether a different more multi-sensory pedagogical approach to explaining the English number system may help the children that have not

	seemed to understand through conventional pedagogical strategies, to move on with their learning. I will explore the potential benefits of using story telling techniques / structured visual image and applying a gesture to go with irregular parts of the number system. This will be done as a short-term intervention programme. I will also be conducting a literature search to explore the following questions: • How are/might storytelling and visual images used as pedagogical tools in other areas of education? • How is the English number system commonly taught? (particularly for those who underachieve?) • Are there other pedagogical strategies for mathematics underachievers?
Level of research, e.g. staff, undergraduate, postgraduate, master's (award related), MPhil, PhD	Master's
Please outline the methodology that would be implemented in the course of this research.	I will be operating in the qualitative paradigm. I will be undertaking a work-based (field) evaluative case study (Robson, 1993). I will explore a pedagogical approach with a group of children using an experimental design. The data collection for the case study will use a mixed methods approach generating both qualitative and quantitative data. <u>Methods</u> I will ask all children, plus both parents/carers and the class teacher to complete a questionnaire before and after the intervention. This data will be coded and

	analysed to explore if there are any changes after the intervention, and also to see if there are any commonalities between participants. The will complete the Numicon Diagnostic Assessment with each child before and after the intervention take place. This will give accurate information about their numeracy skills pre and post intervention programme. This data can be analysed to see if there are any increases in skills. I will make field observation notes during each session. These will be recorded on an evaluative reflection tool that I have designed. I will create a weekly record book that will go home with the children each week. In the book I shall summarise what we have been learning. I will also send home a numeracy related book for parents to hopefully share and then send back. Parents will be encouraged to write a comment in the record book.
Please indicate the ethical issues that have been considered and how these will be addressed.	<u>Responsibilities to the Research Process</u> **High standards of professional integrity, rigour and competence** To ensure the quality and integrity of my research I will set up a Core group consisting of a CREC tutor, a class teacher, a member of the schools' numeracy working group and myself. There is also potential to involve the Dudley Metropolitan Borough Council Maths Consultant. To ensure the quality of questionnaires and letters, these will be drafted and approved by the Core group. I will also send drafts of sections of the research project to my Course Tutor for comments. To ensure the quality and integrity of the intervention sessions, I will complete thorough lesson plans for each session. I will complete thorough observations of what occurred during the sessions and I will make a

	point of doing this after each session. I will reflect regularly on how the study is going and write comments in my learning journal. I already have experience of delivering numeracy intervention projects. I am attending an Advanced Storytelling course in February 2014 to boost my skills. This research project will involve children under 18 years of age. I am CRB cleared. The intervention will be delivered in the school setting. I will adhere to schools child protection policy, for example never working alone with one child in a room without windows/closed door. **Participatory approaches with distributed power in research process:** Children will be given the opportunity to reflect on each of the sessions. Children will be asked to place a picture of themselves on a scale of 1-5 to show how they are feeling. If a child regularly chooses a sad face I will consult with the core team. Children will be expressly told at the start of the study that they can choose to not take part at any time. At the start of the study the children will be told who they can go to if they are unhappy with being part of the study. I am the teaching assistant to the children and the children likely to be involved in the study will already have had experience of coming out of the classroom to work in small groups during the day. We will start ALL sessions sitting in a circle on the carpet and I will sit on the floor with the children. **Data protection and security** I will keep any notes / assessments etc in a folder, which I will either keep with me at all times, or I will put away in a 'staff only' cupboard. The school confidentiality policy and data protection policy will be followed at all times. <u>- responsibilities to participants.</u> **Voluntary and informed consent** I will prepare a script to work from when I initially talk

	to children and invite them to take part in the study, so that in no way could it be claimed that the children were coerced into taking part in the study. This script will be agreed by the CORE group. I will send a letter home to parents to invite their child to take part in the study. The letter will include details of the kinds of activities the children will do, when they will do it, and where. I will introduce myself and offer the opportunity to talk face-to-face with parents. It will very clearly state in this letter that the children will enter into the study voluntarily and that they can choose to discontinue at any time. The intervention programme will not start until I have received written consent for each child. **Anonymity and confidentiality** The identity of the children will not be revealed in the written research project. They will be referred to as Child A, B and C. The school confidentiality policy will be followed at all times. **Participants seen as subjects with rights not objects** Concerns may arise that children will miss out on other activities when they come out of class, perhaps an activity that they would prefer to do? However, the time that children will be taken out of class has been carefully selected to try to avoid this as much as possible. **Regular and open feedback to all participants** We will start each session with a quick recap of the previous session. I will share how I felt it went. Each child will have a weekly record book which I will complete and send home to their parent(s). Parents will be encouraged to write their own comment in the record. <u>-responsibilities toward research output and dissemination process</u> I will state clearly in my written research project that I am not being sponsored at all and that I have funded this study myself. I will write to parents after the

	research study is complete to remind them they can request a copy if they would like.
Please indicate any issues that may arise relating to diversity and equality whilst undertaking this research and how you will manage these.	Is it fair that only the selected school should be involved? I have worked at the primary school for over 7 years. I have a good knowledge of the children, I am familiar with the children, I am familiar with the setting and the staff. This research project would be a lot more difficult to complete if another school was involved. There may be a concern that if this intervention turns out to have a positive impact, that it is unfair that some children experience it rather than others? The research question limits the children that CAN be involved. There is unlikely to be a large sample size available. It is also possible that the parents involved in the study may also have English as a second language and may therefore struggle to read the books with their child. However, the books are intentionally short, and they rely more heavily on the visual images.
Please indicate how participants will be de-briefed about their involvement in the research process and or provided with opportunities for reflection and evaluation	Parents will be asked to complete an exit questionnaire. I will also invite them to come and talk to me at the end of the intervention. During this meeting, parents will be informed of any progress their child has made. They will have the chance to ask questions and will be given information about what will happen with the data from the intervention. Parents will be told that they can request a copy of the research when it is completed. The children will be asked to reflect on how they feel the sessions have gone for them. They will be asked a mixture of open and closed questions. They will record their reflections/evaluations into a tape recorder. The children will be informed of some of the initial conclusions I have come to. I envisage that I will do this as part of a celebratory end of intervention tea party.

Please answer the following questions by circling or highlighting the appropriate response:

1. Will your research project involve young people under the age of 18?

YES **NO**

If yes, do you have an Enhanced Disclosure Certificate from the Criminal Records Bureau?

YES **NO**

2. Will your research project involve vulnerable adults?

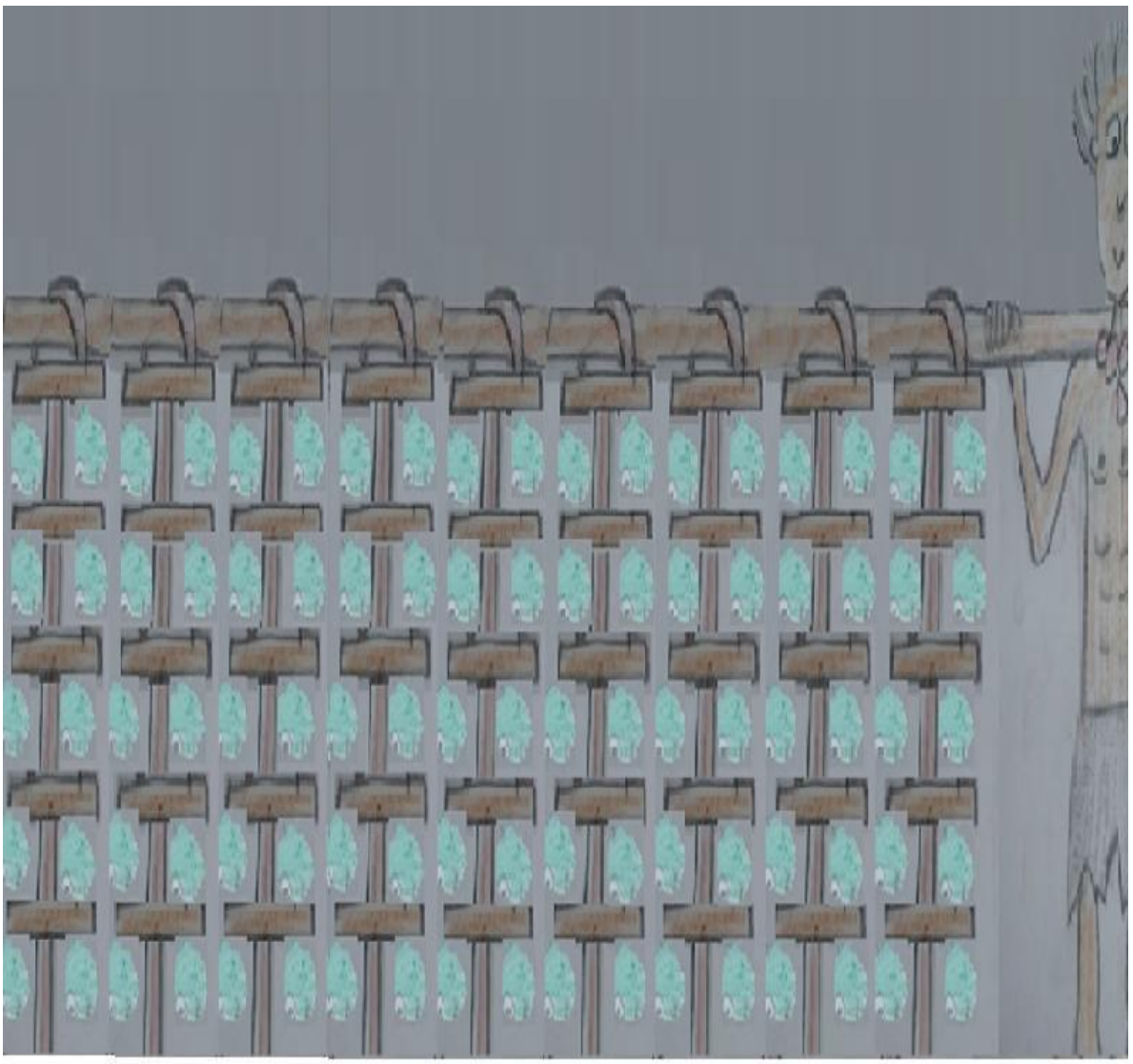
YES **NO**

3. For which category of proposal are you applying for ethical approval?

Category **A** **B**

APPENDIX 5 - Leaflet sent home to parents

Be part of something new!



Dear Parent or Carer,

My name is Deanne Brettle and I am a Teaching Assistant at XXX Primary School. I have worked at the school for 8 years. I am currently completing a research project as part of my Masters in Education degree. I am writing to you today to find out if you will consent to you and your child becoming part of my research study.

WHY AM I DOING THIS RESEARCH STUDY?

Some children struggle to understand our number system. For example, when they see the number 32 they will not understand that this is made up of 3 tens and 2 units. They may also have difficulty distinguishing between "teen" and "ty" numbers.

My research study will look at a different technique to teaching children about the number system. I will be using storytelling techniques to try to help children to understand numbers.

WHAT ARE THE DETAILS OF THE STUDY?

- The study will take 6 – 7 weeks to complete.

- I will meet with your child 3 times a week to work on knowing their numbers to 100 and beyond. This

will be either during assembly time or in the afternoon during lesson time.

- Each session will be no more than 15 minutes and will involve counting objects, counting aloud as a group and different storytelling techniques. We will work in a small group of 4 children.

- I will ask each child and their parents or carers to complete a short questionnaire before and after the study.

- After each session your child will come home with a pack that will include a learning diary and sometimes a maths related story book to share at home.

- You will be most welcome to have a copy of my Masters Research Report when it is completed in July 2014. Please note the children will be referred to as Child A, B, C and D to ensure anonymity.

If you feel this project is something you and your child would like to be part of, I would be delighted if you would you complete the attached consent form.

If you have any concerns about the project or any questions please do not hesitate to ask. Please note if

you and your child consent to take part you may still withdraw from the project at any time. If you agree to take part but then develop concerns you can also talk to Mrs XXX.

Yours sincerely

Deanne Brettle

CONSENT FORM

I agree for_____to take part in the research study of Deanne Brettle. The research study will be looking at a different teaching method to explain the English number system.

I understand that if a difficultly arises that I cannot resolve with Deanne that I can then contact Mrs XXX. I understand that I have the right to withdraw my child at any point during the research study.

Name (please print) _____

Signed _____

Date _____

Relationship to child _____

OR

I would prefer that_____is not involved in the study.

Name (please print) _____

Signed _____

Date _____

Relationship to child _____

APPENDIX 6 – Script for consenting children

CONSENT SCRIPT

Do you know how I sometimes take children out to read in the afternoons, and how Mrs XXX does Talking Maths and ELS? Well I am starting another group called Learn with the Ugs. It is a new group and is part of something I am doing for University.

Your teacher and your parents say it is OK for you to be part of it BUT you have to decide if YOU want to be part of it. I will tell you some more.

You would come out of class 3 times a week on a Monday, Thursday and Friday for about 15 minutes. You would be part of a group of 4 children. You would be learning about numbers to 100 and beyond but in a different way to how you have done it in the classroom.

I will be telling you stories about the how the numbers might have been created. One session you may have to listen to a story, another session you might have to act out the story, another time you might have to play with some toys and act out the story using them. We will also be doing lots of counting and some problem solving.

It will be for about 7 -10 weeks, so until after the Easter Holidays. You will be able to stop at any time if you wish.

I will also have to do a short assessment (like a little test) so I know to start off with exactly what you do know, and then I do it again at the end, to see if you have made progress.

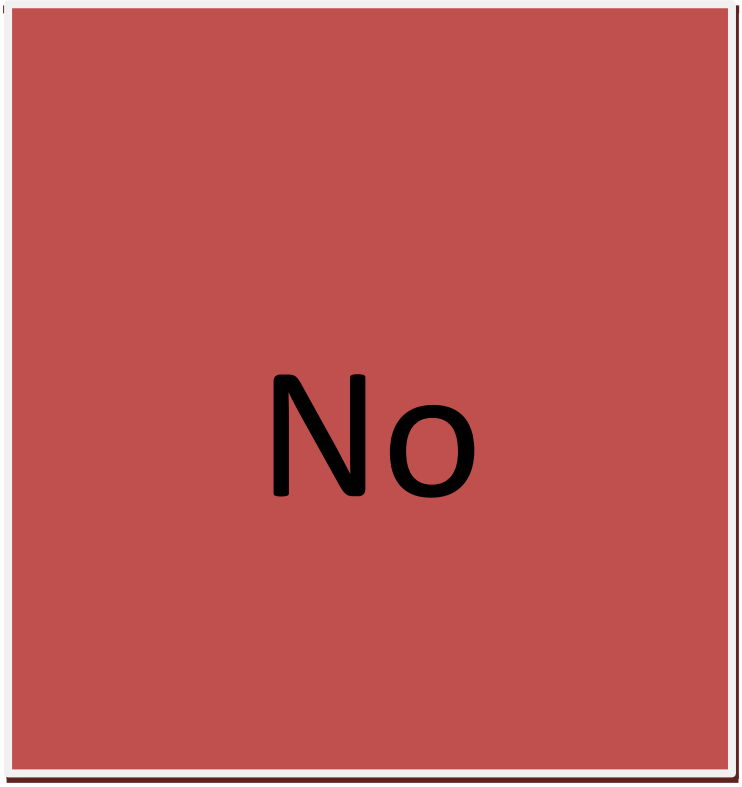
I will send you home after each session with a pack, inside the pack will be a little note where I will write comments about your learning and include a book for your parents to read at home with you.

If at any time you have any problems or worries you can talk to me but if you would prefer you can talk to Miss XXX or Mrs XXX.

Can you let me know one at a time if you want to be part of this new group.

(children to come up one at a time and point to a card that says yes or no)


YES


No

All children sit back down. If they pointed to “no” say

Thank you for your time today, you can go back to class now.

If they pointed to “yes” say

Thank you for agreeing to be part of the group.

Give them the consent form. Say I need to read through these sentences, can you tick the box if you think I have told you that information already.

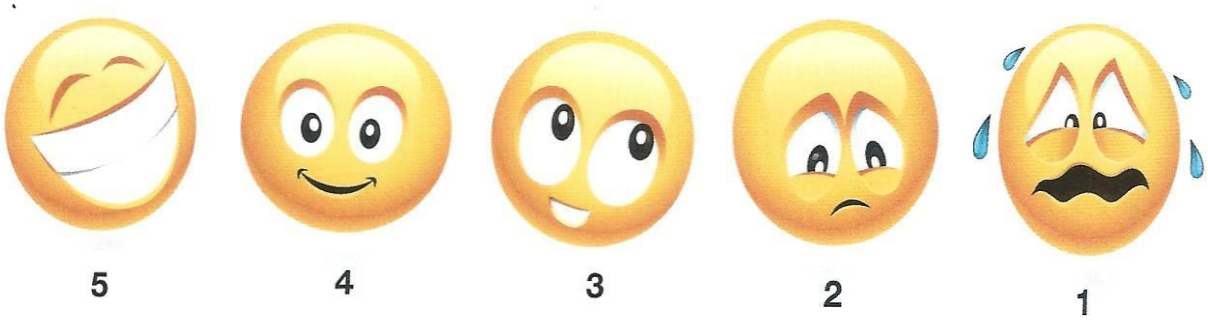
APPENDIX 7 – Questionnaires

CHILD'S QUESTIONS

To be completed by the researcher. Record any further comments in the box below.

Name: _____

Date: _____



1. How do you feel about going to school? Point to the card.

Very Happy Happy OK Sad Very Sad

2. How do you feel about numeracy lessons? Point to the card.

Very Happy Happy OK Sad Very Sad

3. How good do you feel you are at mathematics? Point to the card

Very Happy Happy OK Sad Very Sad

4. How good do you feel your teacher thinks you are at mathematics? Point to the card.

Very Happy Happy OK Sad Very Sad

Record here any other comments the children share

This questionnaire is adapted from the Number Count Attitude survey, Appendix 5 of the Numbers Count Handbook 2010/2011. (Edgehill University, 2011)

CLASS TEACHER QUESTIONS

To be answered by the class teacher about how the child responds in whole class teaching sessions. Record any further comments in the box below.

Child's name: _____

Date: _____

How true are these statements about the child during whole-class parts of mathematics lessons?

	5 Always True	4 Mostly True	3 Sometimes True	2 Rarely True	1 Never True
S/he takes an active part in mathematics lessons.	❒	❒	❒	❒	❒
S/he can think of more than one way to work things out.	❒	❒	❒	❒	❒
S/he is prepared to have a go even if s/he is not sure.	❒	❒	❒	❒	❒
S/he can explain how s/he worked things out.	❒	❒	❒	❒	❒

Do you have any other comments?

This questionnaire is adapted from the Number Count Attitude survey, Appendix 5 of the Numbers Count Handbook 2010/2011. (Edgehill University, 2011)

PARENT'S / CARER'S QUESTIONS

Child's name: _____

Date: _____

How true are these statements about your child and you when s/he is at home?

	5 Always True	4 Mostly True	3 Sometimes True	2 Rarely True	1 Never True
S/he likes to talk about numbers and mathematics in everyday situations.	❒	❒	❒	❒	❒
S/he tells me about the mathematics s/he is learning at school.	❒	❒	❒	❒	❒
I like to help her/him to learn mathematics.	❒	❒	❒	❒	❒
I know how to help my child improve his/her mathematics.	❒	❒	❒	❒	❒

	Strongly Agree	Agree	Unsure	Disagree	Strongly Disagree
I had a positive experience of mathematics at school.	❒	❒	❒	❒	❒
I have a positive attitude towards mathematics.	❒	❒	❒	❒	❒

Do you have any other comments?

This questionnaire is adapted from the Number Count Attitude survey, Appendix 5 of the Numbers Count Handbook 2010/2011. (Edgehill University, 2011)

APPENDIX 8 - Research Proposal

Student Name: Deanne Brettle		Supervisor: Chris Pascal			
Single Research Project		**Double Research Project**	**x**	**Dissertation**	

The contents of this form should be discussed with your supervisor at your first tutorial

Write a short paragraph describing the focus of your research.

Research has shown that one of the key things that can stop a child from progressing in numeracy is their inability to understand our Place Value System. For example to know that 5 groups of 10 and 2 more is 52. A further barrier to progression is that they have difficulty distinguishing between "ty" and "teen" numbers (DCSF, 2009). In the English language we use two parallel systems for naming numbers which do not always agree with each other. We use a written symbolic system (numerals) and we also use a spoken and written verbal system (words) to say and read our number names. These systems conflict with each other. During the eight years I have worked in a primary school I have observed that some children are able to overcome these irregularities but for others it seems harder to grasp.

I want to explore the current pedagogical approaches to teaching children about the number system and also explore whether a different more multi-sensory pedagogical approach to explaining the English number system may help some children move on with their learning.

Recent years have seen a surge of interest in the power of oral storytelling in both therapeutic and educational contexts (Grove, 2013). I would like to investigate whether combining different storytelling techniques may help further a child's understanding of our English number system. The techniques I will include are: listening to a story; embellishing and developing a story; reading a story book aloud; acting out a story and retelling a story.

I propose to do this alongside using a structured visual image each time we talk about an amount/quantity, this will build on the highly successful Numicon approach of using structured apparatus (Tacon, Atkinson and Wing (2004)).

I will also encourage children to make a gesture to coincide with an irregular part of the number system. I will explore whether the children in the study feel that producing a gesture to go with a numeral/quantity helps them to remember it better.

My intention is to not only track if the children have gained in academic ability but to also observe whether children consider this more multi-sensory approach to be engaging and motivating.

The Williams review of Mathematics Teaching in Early Years Settings and Primary Schools (2008) confirmed that the UK is still one of the few advanced nations where it is socially acceptable – fashionable, even – to profess an inability to cope with the subject. An independent charity called National Numeracy focuses on adults and children with low levels of numeracy. They share my opinion that if numeracy levels are going to improve we need to make a start at trying to change attitudes. The charity National Numeracy state the impact of this negative attitude to maths is huge. They ask if it is OK to be 'bad at maths' then will children believe maths is not important? Does it make people less likely to want to improve their skills? If you label yourself as bad at maths, will this become a self-fulfilling prophecy?

I will involve the parents of the children who are in the study, by sending home weekly a numeracy related book to share. The parents will be asked to read the book to their child and also read the back cover of each book. The KEY message in every book will be that if we have negative emotions about mathematics it is really not a good thing to pass these on to our children. The back cover page will also give simple useful ideas of how to engage their child in mathematics in the real world. I will ask parent's to complete questionnaires about their attitude to maths at the start and end of the research project.

List your proposed research questions and/or hypothesis.

How might storytelling and structured visual images be used as a pedagogical strategy by practitioners in furthering the understanding of the English number system for children in Key Stage One who are underachieving in mathematics ?

<u>Sub-questions</u>

How are/might storytelling and visual images used as pedagogical tools in other areas of education?

How is the English number system commonly taught? (particularly for those who underachieve?)

Are there other pedagogical strategies for mathematics underachievers?

List the area(s) of literature to be reviewed and the key authors you intend to refer to.

The literature review will be in sections:

Numeracy – the current climate and the BIG ISSUES – I will be reviewing;

- DCSF (2009) *Overcoming barriers in mathematics, helping children move from level one to level 2*
- Grove, N. (2013) *Adults with Special Needs : Transforming lives through telling tales.* Routledge
- Hopkins, C., Pope, A., and Pepperell, S.,(2013), *Understanding Primary Mathematics*. David Fulton Publishers.
- Porkess, R., (2011) *A world class mathematics education for ALL our young people*, a task force chaired by Carol Vorderman with lead author Roger Porkess

http://www.nationalnumeracy.org.uk/resources/15/index.html accessed January 2014
- Thompson, I., (2010) *Issues in Teaching Numeracy In Primary Schools*. Open University Press
- Williams, Peter., (2008) *The Independent Review of Mathematics Teaching in Early Years Settings and Primary Schools.* DCSF Publications

Influential theories and concepts

- Dolya, G.(2009) *Vygotsky in Action in the Early Years: The Key to Learning Curriculum*. Taylor & Francis
- Goleman, D., (2011) *The Brain and Emotional Intelligence: New Insights.* More than Sound LCC
- Pound, L. and Lee, T. (2010) *Teaching Mathematics Creatively.* Routledge

Storytelling as pedagogy

- Daniel, A., (2011) *Storytelling across the primary curriculum.* Routledge
- Pound, L. And Lee, T. (2010) *Teaching Mathematics Creatively.* Routledge
- Grove, N., (2013) *Using Storytelling to Support Children and Adults with Special Needs : Transforming lives through telling tales*. Routledge

Structured visual imagery as pedagogy

- Tacon, R., Atkinson, R., and Wing, T. (2004) *Learning about numbers with patterns using structured visual imagery (Numicon) to teach arithmetic.*
http://www.numicon.com/Libraries/images/Learning_about_numbers_with_patterns.sflb.ashx accessed January 2012

Using gesture to increase cognition

- McNeill, D., (2012) *How Language Began.* Cambridge University Press Textbooks.

Methodology Reading

- Robson, C., (1993) *Real World Research.* Blackwell Publishers Inc.
- Stakes, R., (1995) *The Art of Case Study Research.* Sage Publications.
- Elia, I., van den Heuvel-Panhuizen, S. and Georgiou, A. (2010) *The role of pictures in picture books on children's cognitive engagement with mathematics*. European Early Childhood Education Research Journal Vol.18, No3, September 2010, 275-297.

Describe the research methodology that you intend to use (Quantitative, Qualitative, Critical).

I will be operating in the qualitative paradigm. I will be undertaking a work-based (field) evaluative case study (Robson, 1993). I will explore a pedagogical approach with a group of children using an experimental design.

The data collection for the case study will use a mixed methods approach generating both qualitative and quantitative data.

Describe the research methods that you will use (observation, interviews, concept map) and provide an indication of your sample size(s) and how you will analyse the data.

I will complete a literature review. I will consult a wide variety of databases. This will include the BCU online library, ERIC (Educational Resource Information Centre), British Education Index, EPPI centre and ESRC UK Centre for Evidence Based Policy and Practice. I will also use the library at CREC (Centre for Research into Early Childhood) and the main Birmingham City Centre Library. In addition I will search government websites such as the National Strategies Archive website. I will use the website of the charity National Numeracy. The details of each item I read will be entered into a 'Literature Review Matrix'. This will help enable me to identify themes and areas where there are gaps. I will label each item read with A,B or C to help remind me which items are more pertinent than others and which I should consider including in my written literature review.

For the field research, I will use a sample of 4 children from the Key Stage One phase of the Primary School I work at which is in the West Midlands. A core group will be set up containing the Assistant Head teacher, the class teacher, my CREC tutor and a numeracy working group member. Members of the core group will help me to identify within Key Stage One, the children who meet the criteria for the study. They will need to be:

- In Key Stage One
- Underachieving in mathematics ability*
- Struggling with issue of place value and/or the 'ty' and 'teen' numbers

*I will look at the Average Point Score (APS) data to determine whether a child is underachieving. For example according to the 'The National ruler for measuring children' (see appendix 9) the APS score for a child in Year 2 in the spring term is 14. So any score well below this will be taken as underachieving.

After written consent from parents is obtained the children will become part of an intervention group led by myself. We will meet for no longer than 15 minutes a day, three times a week, to listen to/ talk about/ embellish / retell /act out stories about the English number system. We will also practice counting out objects into groups of ten and we will count together whilst looking at a matching visual image on a PowerPoint presentation. When we reach an irregular part of the number system when we are counting together, such as 13 we shall make a gesture to go with it. We will also practice writing numbers.

Methods of data collection

1. Questionnaires will be completed pre and post intervention by:
    - both parents of each of the children taking part.
    - the children taking part
    - the child's numeracy teacher

   This will be done to gather information about attitudes to numeracy. This qualitative data will be analysed to look for any commonalities and any changes over time. The results of these questionnaires will be coded and analysed. There will be 4 questions where the person completing the questionnaire will tick whether the statement is: always true/mostly true/sometimes true/rarely true/never true. There will also be a box where the person completing the form will be encouraged to write down 'any other comments'.

2. I will use the Numicon Diagnostic Assessment Tool to complete an assessment of the children's current knowledge of the English number system both pre and post intervention. Any changes in mathematical skills can be tracked using these assessments. This will enable me to provide data such as Child A before the study knew how to write 42% of the numbers they were asked to write in the range of 0-100. After the study Child A knew how to write 64% of the numbers they were asked to write.
   When evaluating the impact of the intervention, I will also consider the comments from their Class Teacher, their teacher-assessed Average Point Score/Level and their performance in end of year written tests e.g. SATs if this data is available.

3. I will design an evaluative reflection tool. This will include a detailed lesson plan and space for detailed observation notes for each session. I will make notes on the comments the children make in response to the stories and whether these are story-related comments or mathematical related comments. I will code the observations by drawing on the categories identified by Elia, van Den Heuval-Panhulzen and Georgiou (2010). I will also record my own reflections about each session and shall categorise these into "what went well" and "even better if".

4. I will also record general reflections about the progress of the research project in my Learning Journal, for example if I have had occasion to consult with the core group about something.

5. At the end of each session children will be asked a question that will require them to reflect on the session. They will be asked to place a picture of themselves on a scale of 1 to 5. The scale will have accompanying appropriate faces, e.g. sad face / smiley face. This is an attempt at trying to measure how engaged they felt in the session. I shall compare the scores they give themselves to my own observations.

6. At the end of the programme the children will have the opportunity to reflect on the intervention programme as a whole. They will record their thoughts into a tape recorder, which will then be analysed looking for "what went well, the WWW's" and "even better ifs, the EBIs". I will compare their WWWs and EBIs to the field observations notes I have made and see if there are any commonalities / things I had not observed.

Provide a timetable or flow chart of where, when and how you intend to undertake the research.

Please see Gannt diagram attached.

Student Signature: **Date:**

Supervisor Signature: ---------- **Date:** .....

Module Leader Signature: ---------- **Date:** ------

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Title of Research:	

Comments:

APPENDIX 9 – The national ruler for measuring children's progress

ANNEX

The national ruler for measuring children: version 1

	Age	Year	Term	Points	NC Level	GCSE
	Typical 3-year-old		Autumn	1	Wc	
			Spring	2		
			Summer	3	Wb	
FS	Typical 4-year-old	Year N	Autumn	4		
			Spring	5	Wa	
			Summer	6		
	Typical 5-year-old	Year R	Autumn	7	1c	
			Spring	8		
			Summer	9	1b	
KS1	Typical 6-year-old	Year 1	Autumn	10		
			Spring	11	1a	
			Summer	12		
	Typical 7-year-old	Year 2	Autumn	13	2c	
			Spring	14		
			Summer	15	2b	
KS2	Typical 8-year-old	Year 3	Autumn	16		GCSE G
			Spring	17	2a	
			Summer	18		
	Typical 9-year-old	Year 4	Autumn	19	3c	
			Spring	20		
			Summer	21	3b	
	Typical 10-year-old	Year 5	Autumn	22		GCSE F
			Spring	23	3a	
			Summer	24		
	Typical 11-year-old	Year 6	Autumn	25	4c	
			Spring	26		
			Summer	27	4b	
KS3	Typical 12-year-old	Year 7	Autumn	28		GCSE E
			Spring	29	4a	
			Summer	30		
	Typical 13-year-old	Year 8	Autumn	31	5c	
			Spring	32		
			Summer	33	5b	
	Typical 14-year-old	Year 9	Autumn	34		GCSE D
			Spring	35	5a	
			Summer	36		
KS4	Typical 15-year-old	Year 10	Autumn	37	6c	
			Spring	38		
			Summer	39	6b	
	Typical 16-year-old	Year 11	Autumn	40		GCSE C
			Spring	41	6a	
			Summer	42		
Post 16	Typical 17-year-old	Year 12	Autumn	43	7c	
			Spring	44		
			Summer	45	7b	
	Typical 18-year-old	Year 13	Autumn	46		GCSE B
			Spring	47	7a	
			Summer	48		
Higher Education	Typical 19-year-old	Year 14	Autumn	49	8c	
			Spring	50		
			Summer	51	8b	
	Typical 21-year-old	Year 15	Autumn	52		GCSE A
			Spring	53	8a	
			Summer	54		
	Typical 22-year-old	Year 16	Autumn	55	9c	
			Spring	56		
			Summer	57	9b	
			Autumn	58		GCSE A*